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The SCIENTIFIC MONTHLY

April 1945

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THE SCIENTIFIC MONTHLY

APRIL, 1945

ETHICOGENESIS*

By CHAUNCEY D. LEAKE

To approach the problem of ethics in a scientific manner is difficult. Such an approach is so far away from the traditional metaphysical tee of classical philosophy. The green of evidence is small; the fairway of procedure is narrow and dog-legged; the rough of religious bias at the side is thick, and there are a myriad of psychological traps to by-pass.

Scientific workers do not speak the same language as professional philosophers. From the viewpoint of professional philosophers, a discussion of ethics by a professional scientific worker may seem naïve. However, to the professional scientific worker, discussions on morals by professional philosophers usually appear to be metaphysical irrelevance in the face of our present knowledge. New raw data for a new approach to philosophy is to be derived especially from the results of studies in semiotics, physiology, neurology, experimental psychology, psychiatry, psychoanalysis, and sociology. Perhaps dialectic or dynamic materialism as new philosophical developments will utilize this evidence.

It is significant that recent philosophers, such as Herbert Spencer (1820–1903), William James (1842–1910), John Dewey (born 1859) and his pupils, are advocating the application of the scientific method, and especially controlled experimentation, to all fields of human activity and interest, including art, politics, and ethics.[1] Perhaps as Durant suggests,[2] it is high time that scientific workers and historians, as well as philosophers, begin to show some respect for Spencer's brilliant example of what may be undertaken philosophically with the rapidly accumulating knowledge at our disposal.

The differences between the traditional philosophical and the scientific approach to man's place in the universe, and thus to his ethics, have recently been exemplified by a popular series of articles published during 1942 in *Fortune*. Professors Sperry, Maritain, Montague, and Hocking indicate that while the scientific and relativist approach is adequate and essential, it is incomplete and must be supplemented by metaphysical or supernatural considerations, such as "moral universals," Christian theology, "an ideal good operating in nature," or "the conscious purpose of God." On the other hand, Julian Huxley[3] expressed the implications of the scientific position. This approach rejects a metaphysical dualism of body and soul or matter and mind because of lack of demonstrable objective experimental evidence. It finds no evidence for the objective existence of "immutable and absolute principles of Truth, Beauty and Goodness." Huxley shows that the available evidence justifies the conclusion that these concepts are the relative ideals of different humans, and that they are related to the solid conditions of our environment, as individual and social adaptations.

Julian Huxley agrees with A. J. Carlson[4] in pointing out that the answer to the question of the insufficiency of science is more science. Huxley says, "the scientific approach, empirical and where possible experimental, refusing the absolute for the relative, and rejecting the deductions of pure reason except when based upon the inductions of raw fact, cannot be rejected as insufficient until it has been completely tried

* Address of the Retiring Vice President (1940), Section L—History and Philosophy of Science, American Association for the Advancement of Science, Cleveland, Ohio, September 13, 1944.

out." In accordance with this suggestion, it is refreshing to find some current philosophers, such as Lepley,[1] willing to undertake the application of the scientific method of experimentation to the problems of values and ethics.

Our current knowledge of ourselves and our brains, especially as revealed by the results of experimental studies in physiology, neurology, and psychology, and as confirmed by the observations of psychiatrists and psychoanalysts, justifies fully the extension of the scientific method of procedure in philosophy to the exclusion of the now semiotically invalidated metaphysical approach. In spite of Bergson's reaction against Darwinism, the significance of the evolutionary concept is great enough to conclude with Hugh Miller[5] that, "With his demonstration of the evolution of natural types, Darwin fulfilled the intention of empirical thought, and closed the portals forever upon traditional philosophy. Metaphysicians may continue to announce their speculations about the everlasting structure of things, and about the universal criteria of knowledge; but their devotions are a wake, administered to a corpse."

Evolutionary Factors in Ethicogenesis

As far as our records of human thinking go, we seem always to have required justification for our moral ideas, either through fear or favor of supernatural agencies to whom our morals may have been ascribed, or through respect for the abstractions we may set up intellectually from our general experiences. While there may always have been implied some relationship between our knowledge of ourselves or our experiences with our environment, and our ideas of what is right and wrong, most of our ethical ideas seem first to be expressed under primitive social conditions as injunctions from supernatural agencies. What psychological skill a Moses must possess to impose upon his people a decalogue!

Through fear of reprisal or promise of reward, religious leaders continue to exhort their followers to respect the purposes and motives sanctioned by their deity. This pattern is exemplified in our culture by a succession of moral injunctions. There is thus the Mosaic, Prophetic, and Messianic literature of the Jews, in which the motivating factor employed is chiefly fear of punishment by either the actual, or the social, or the anthropistic "father." The net effects of this have been individually inhibitory in repressing ordinary desires which experience may demonstrate to be anti-social.

It is interesting that Charles Darwin[6] (1809–1882) should have anticipated and refuted Reinhold Niebuhr's[7] recently expressed objection to A. Comte's[8] (1798–1857) notion of the familial origin of morality. In expressing doubt as to man's uniqueness in self-consciousness, he asks, "At what age does the newborn infant possess the power of abstraction, or become self-conscious, and reflect on its own existence? We cannot answer; nor can we answer in regard to the ascending organic scale. . . . The difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind. . . . Actions were probably regarded by primeval man as good or bad solely as they obviously affect the welfare of the tribe, not that of the species, nor that of an individual member of the tribe." The moral lag resulting from too great adherence to this gangster (or nazi or fascist) code is caused, says Darwin, by the operation of three factors: first, confinement of sympathy to the same tribe; second, power of reasoning insufficient to recognize the bearing of self-regarding virtues (as temperance) on the welfare of the tribe; and third, weak power of self-command not strengthened by habit, instruction, and religion,—and Darwin even surmised by inheritance!

There has also been a legalistic development of familial morality by which, in our "laws," we agree on the least common denominator of what we will implicitly allow each other to do without punishment or repression. The basis of primitive codes of law is always the *lex talionis*, in which obedience is obtained through fear of reprisal.

This primitive negative inhibitory effort is also illustrated by the Buddhistic phrasing of the Golden Rule, "Do not do unto others what you would not have others do to you."

Under Christian influence a more positive expression, operating through hope of reward, became current, "Do unto others as you would have others do to you," or "Love your neighbor as yourself." Hope of individual future reward is also operative in exhorting blind obedience to specific codes of conduct as among Mohammedans and the Japanese.

When more sophisticated societies arise and systematic thinking is undertaken, philosophers continue to exhort people to follow particular lines of conduct sanctioned by rationalizations. Perhaps the great intellectual effort of Immanuel Kant (1724–1804) culminating in the "categorical imperative,"[9] will remain the outstanding example of this tendency.

Whether hedonistic or idealistic, whether utilitarian or individualistic, or whether advocating absolute or relative standards of goodness and badness, the classical ethics of philosophical thought remains religiously a matter of persuasion, of exhortation, and of rationalizing what it is that we "ought" to do, or "ought not" to do. It is dogmatically "normative" and has scarcely considered the "descriptive" approach characteristic of scientific effort.

Occasional groups have frequently achieved a high moral standard of conduct by voluntary, conscious, and premeditated agreement, pledged by vows or oaths which, however, derive their force from either fear of reprisal or hope of reward. An early example of this ethical effort is the famous "Oath of Hippocrates," the basis for all professional ethical codes.[10] This tendency continues to operate extensively in religious orders and secret societies.

During the whole apparent development of our ethical consciousness, there has been, as A. J. Carlson says,[11] an implication that our "purposes or aims are modified by our growing understanding of ourselves and our environment." This knowledge is now beginning to be enough to set the limits to what it is *possible* for us to believe, or to achieve, no matter how greatly we may want to. Our chief difficulty these days is that our present knowledge of ourselves and of our environment does not permit us to believe honestly the dogmas to which we cling, and we lack the ability to devise methods of obtaining general social credence for what is possible to believe.

The basic problem, of course, is what we can agree upon as "truth." The Platonic problem of ideas still troubles us, and the modern interest in semantics has not yet satisfactorily resolved the difficulty. Even scientific endeavor itself, the business of which is the establishment of "truth," may occasionally fall into the trap by thinking of "science" as something real in itself![12]

In scientific work, "truth" as a symbol means an intellectually coherent but admittedly tentative explanation of ourselves and our environment which has been objectively demonstrated and *agreed upon* by those who have investigated it. Walter Lippmann illustrates the point by emphasizing its antithesis: "The unscientific man, like the Schoolmen of the Middle Ages, really means by the truth an explanation of the Universe in terms of human desire."[13] Along with Charles S. Pierce, he points to *agreement* as a necessary factor in the appreciation of "truth." What we mean by the truth is the opinion *agreed to by all who investigate*, and it is the object represented in this opinion that is the real.

Most scientific investigators who have philosophical inclinations agree to this concept of approximating the "truth." The scientific position has been well expressed by Edwin Grant Conklin, Emeritus Professor of Biology at Princeton University, once President of the American Association for the Advancement of Science, and now President of the American Philosophical Society. According to Conklin,[14] the spirit of science implies not only freedom to hold and express any view for which there is rational evidence, but also recognition that knowledge of ourselves and our environment is incomplete and subject to revision, and that there is no legitimate compulsion to belief beyond the voluntary acceptance of demonstrably rational evidence. As Carlson[4] puts it, in agreement with Julian Huxley, the essence of the scientific method is the rejection *in toto* of all non-observational and non-experimental authority in the field of experience. Conklin identifies the aim of science with that of religion,

to know the "truth" about ourselves and our environment, with confidence that even unwelcome "truth" is better than cherished error.

The scientific method of arriving at the "truth" is now well defined in theory and practice. On the one hand, one may try to build a coherent ideal structure within the rigid limitations of logical consistency, by means of *experimental reasoning*. With this ideal structure, some details of the universe about us may be found to correspond. This is the way of mathematics. On the other hand, one may observe and describe as accurately as possible oneself and one's environment. A tentative explanation may then be suggested of ways by which an individual and his environment may operate. The validity of this tentative explanation may then be *tested by experiment*, which seeks to isolate and control specific factors. Conclusions are reached in accordance with the results of such experiments. This is the way followed in the natural sciences.

The knowledge of ourselves and our environment acquired by these methods has vastly altered the entire character of our living. We are discovering that knowledge about ourselves and our environment makes it possible for us to add significantly to the broad and lasting satisfactions of us all. This suggests at once that scientific endeavor has moral value.

With increasing knowledge derived from the various levels of scientific endeavor, it now appears that we have sufficient facts of a verifiable nature regarding ourselves and our environment to estimate the moral value of their implications; that is, to determine their ethical significance. As W. M. Malisoff would insist,[15] when a fact is recognized, its conjugate, which is its value, at once becomes important.

From a consideration of our biological knowledge, the implication is clear at once that survival for an individual living thing or for a particular living species, is "good" for that individual or that species. Whatever is conducive toward the continued survival of that particular individual or that particular species is therefore "good" *for it*. As Harold Blum suggests,[16] the operation of the second law of thermodynamics makes it impossible, i.e., highly improbable, for living species now extinct ever to emerge or to appear again in this environment. Survival is "good," therefore, in the very significant sense that if the species fails to survive, "goodness" has no further meaning for that species.

The problem then is to determine those factors of "goodness" which are common to all species; that is, the basic factors conducive to the survival of *all* species. This at once requires consideration of the *relationships* between individuals or species, or groups of living things. On this basis, whatever preserves the "balance of nature" is therefore "good." My helpful colleague, Dean A. P. Brogan, suggests that this is the essence of the "harmony theory" of ethics, as implied by Aristotle and as developed more recently by William James, G. H. Palmer, John Dewey, and L. T. Hobhouse.

As a living organism, man is peculiar in that he seems to be the only living thing capable of significant self-conscious control of himself and his environment. That control is dependent upon his increasing knowledge of himself and his environment. Warner Fite makes this the basis of his philosophy of individualism.[17] He holds that the human individual as a conscious agent is the source and measure of all value. However, he points out that the interests of conscious individuals are essentially harmonious, but only so far as they are conscious. Fite reconciles individuality with social unity, which George Sarton considers to be the most important modern problem,[18] by pointing out that the same knowledge which brings an individual to be self-regarding, shows him to be living in a world with others whose conduct determines for him the conditions through which his own interests are to be satisfied, and whose interests therefore it is wise to consider.

All "normal" living things seem to be able to act in accordance with those principles which are conducive to their survival. This indicates the operation of adaptive factors. It also implies adjustable adaptation in the face of changing environments.

John Dewey and C. H. Waddington both

use the example of the burned hand to indicate the factors involved: "The answer to the question 'Why not put your hand in the fire?' is the answer of fact. If you do, your hand will be burnt. The answer to the question, Why acknowledge Right? is of the same sort. For Right is only an abstract name for the multitude of concrete demands in action which others impress upon us, and of which we are obliged, if we would live, to take some account."[19]

Emphasis on the phrase "if we would live" indicates the significance of adaptation in survival and the importance of adjustment to environmental conditions as a factor in survival. While it may be difficult to ascribe a desire for living to all living things, yet the adaptations which have been made in the past to environmental conditions have resulted in the survival of all those living things which are on the earth now. Living things and their environments react upon each other to produce an adjustment which is conducive toward survival. This is the point of Lawrence Henderson's thesis concerning "The Fitness of the Environment."[20] The physiological conclusion is that we are part of a generalized dynamic equilibrium which includes life, and which operates within the circumscribed limits of the physical factors of this world.[21]

Attacks on the Intellectual Validity of Ethics

In introducing a remarkable discussion on the relations between science and ethics, C. H. Waddington, Lecturer in Zoology at Cambridge University,[22] says that throughout our history our concept of goodness has been considered to have or to require intellectual validity, whether deduced from observation, as in the theory of utilitarianism, or revealed by supernatural agencies. Recently, however, four lines of thought have developed which appear to "rob ethical statements of any claims to intellectual validity." These are (1) psychoanalytical study, which suggests that our ethical systems are products of our early reactions, sexual or otherwise, to family life; (2) anthropological investigations comparing various social systems, and indicating that ethical beliefs differ extremely from culture to culture and therefore have no general validity; (3) Marxists' efforts, asserting that ethical systems are expressions of class forces, and (4) the antimetaphysical attempt of the logical positivists in studying meaning, and developing semantics, and holding that ethical statements have no meaning of a verifiable nature.

Waddington feels that these four approaches, far from indicating that science has nothing to do with ethics, show on the contrary that ethical judgments may be statements of the same kind as scientific statements. He feels that ethics is based on facts of the kind with which science deals and that science may reveal "the nature, the character and direction of the evolutionary process in the world as a whole, and the elucidation of the consequences, in relation to that direction, of various courses of human action." He concludes that "the real good cannot be other than that which has been effective; namely, that which is exemplified in the course of evolution." Waddington holds that our moral systems represent ways by which we adapt ourselves to our environment, and thus become able to take part in our own evolutionary progress.

Originally published in *Nature*, this statement by Waddington provoked a considerable reaction. Amazingly, but characteristically British, this discussion continued for several months in *Nature* during the very period when England was being subjected to its bitterest experiences in the war.

While our English colleagues were so realistically surveying the ethical situation, many scientists on this side of the Atlantic were also anxiously exploring the matter. American scientists have recently been placed on the defensive as a result of the rather superficial opinion, widely expressed, that the war and all our other evils have been brought upon us by the development of science. It is easy for demagogues to confuse what is called "science," the voluntarily agreed upon knowledge we have of ourselves and our environment, with the applications, beneficial or evil, which may be made of this knowledge. American scientists naïvely demonstrated their sense of insecurity by the disturbance among them which these charges

caused. For several years, however, American scientists have been struggling to build a firm scientific basis for ethics.

The pages of *Science* and THE SCIENTIFIC MONTHLY for the past decade contain many addresses and articles by American scientists on the relations of science to ethics. Some of these are naïve and reflect the childhood conditioning of their authors, while others are quite sophisticated, and some are difficult to comprehend.

It is interesting to discover, however, that three distinguished American biologists, from three different cultural centers on this continent, could reach substantial agreement with Waddington on biological factors which might be significant in the development of ethical ideas. Different considerations led to the same conclusion on the part of Edwin Grant Conklin, Emeritus Professor of Biology at Princeton, C. Judson Herrick, Emeritus Professor of Neurology at the University of Chicago, and Samuel J. Holmes, Emeritus Professor of Zoology at the University of California.

Conklin says:[23] "Biologically life is maintained by continual balance, co-operation, compromise, and the same principles apply to the life of society. The highest level of human development is attained when purpose and freedom, joined to social emotions, training, and habits, shape behavior not only for personal but also for social satisfaction. Conduct bringing the broader and more lasting satisfactions is the better." Herrick remarks:[24] "That social stability upon which the survival and comfort of the individual depend and that moral satisfaction upon which his equanimity, poise and stability of character depend, arise from the maintenance of relations with his fellow men which are mutually advantageous." Holmes states:[25] "Morality becomes just one phase of the adjustment of the organism to its conditions of existence. As a good body is one that runs smoothly and efficiently in the maintenance of its vital functions, so a good man is one whose conduct not only maintains his own life on an efficient plane, but conduces to the enhancement of the life of his social group. Peoples may believe that their moral customs derive from a supernatural source, but one potent reason for their adoption is their conduciveness of survival." These opinions are in agreement with those expressed by John Dewey and his followers as a result of more strictly philosophical studies: "A morals based upon study of human nature instead of upon disregard for it would find the facts of man continuous with those of the rest of nature and would thereby ally ethics with physics and biology."

The ethical significance of this point of view appears in relation to survival. There is a better chance for continuing existence for that individual or group which adjusts itself harmoniously toward other individuals or other groups than for that which does not. In adjustments of individuals or groups in harmonious conduct towards each other there is a greater tendency toward mutual satisfaction and benefit than when such adjustment does not exist. As Lepley puts it, "The forces of life and existence afford constant and recurring dynamic for attempts to make satisfactory adjustments. In these attempts, intelligence and reason are increasingly needed. They are and will be effective, so far as they can be, in the degree that they operate as elements within an inclusive experimental procedure."[1] Adaptation toward the goal of mutual satisfaction might become the basis of effective "biological engineering."

Conklin has emphasized the importance of training in promoting harmonious adaptation: "In all normal human beings it is possible to cultivate unselfishness, sympathy rather than enmity, co-operation rather than antagonism. Human nature can be improved by human nurture." The whole course of education over the centuries is predicated upon this premise.

A NATURALLY OPERATIVE ETHICAL PRINCIPLE

If our scientific knowledge of ourselves and our environment has ethical consequences, it should be possible to discover an operative natural principle with respect to human conduct which can be stated in descriptive terms. We should be able so carefully to observe factors of importance in

human conduct as to describe accurately what these factors are, without permitting the intrusion into our effort of the emotions of fear or desire. There seems to be little point in exhorting men to be good. That has been the way of the moralists for centuries and it hasn't worked with startling success. Neither fear of punishment nor hope of reward has been particularly fruitful in promoting good conduct among men. There has hardly been sufficient knowledge to obtain agreement as to what constitutes "goodness" and "right." Now that we are acquiring such knowledge, we might attempt more satisfactorily to elucidate the "good," and thus make the burnt hand example applicable.

For centuries philosophers and moralists have wrestled with the problem of human conduct from the standpoint of either absolute or relative criteria for "goodness" and "right." Our knowledge of ourselves and our environment now indicates that this debate is irrelevant. We can appreciate now that our verifiable and agreed-upon knowledge of ourselves and our environment continually increases and is subject to revision. In this sense we now understand that "truth" is relative. However, the probability of its being more precise and exact increases with our scientific endeavor. Similarly, it appears that our concept of "goodness" and "right" is also relative. It is subject to revision as our concept of "truth" changes in accordance with the increase in our verifiable and agreed-upon knowledge of ourselves and our environment.

With the scientifically established "truth" about living things which we now possess, we are in a position to search for operative principles in Nature which may have moral significance. We can agree that for any individual or group of individuals it is "good" to survive. However, individuals and groups of individuals are in contact with other individuals and other groups. For these other individuals and other groups, survival is also "good." Relationships between the individuals or groups in contact with each other to be "good" must therefore be conducive toward the survival of all concerned. The adjustments of living things to each other and to their environment appear to be predicated on this effort to survive.

A survey of this sort can be extended to include human relationships, or behavior patterns between humans, with specific reference to their ethical connotations. One such notable attempt was made on July 3, 1939, in a secluded redwood grove in the Santa Cruz Mountains, California. The occasion was pleasantly described by C. Judson Herrick.[26]

The American Association for the Advancement of Science had met in Palo Alto. It was thought that some of the guests at the meeting might be interested in a picnic in the redwoods. The Pharmacology Laboratory of the University of California Medical Center in San Francisco had been accustomed to spend Sundays in seminar discussion in a redwood grove on the San Lorenzo River. To one of these meetings Edwin Grant Conklin, C. Judson Herrick, and Olaf Larsell were invited. In honor of our guests, the seminar discussion took the form of a debate between Otto Guttentag and Charles Gurchot on the influence of German and French philosophers on the biological sciences. This discussion provided a springboard for those who were assembled together under the sheltering arms of the redwoods to discuss a biological basis for ethics.

The conversation developed as to whether or not it might be possible to discover a naturally operative principle that governs human conduct. It was appreciated that such a principle might be of the same character as the principle of the conservation of energy. To be naturally operative, the principle would have to function whether we are aware of it or not, or whether we like it or not. However, it was clear in the discussion that if we could recognize it, it might be helpful to us by indicating the manner in which we could take advantage of it to our benefit. Certainly it has been helpful since Helmholtz's brief formulation to appreciate the principle of the conservation of energy!

As a tentative statement of such a principle, we induced from the plethora of examples in universal experience the following: "*The probability of survival of a relationship between individual humans or groups*

of humans increases with the extent to which that relationship is mutually satisfying." This statement may be formulated in other ways, to emphasize different considerations: "The more a relationship between human individuals or groups is mutually satisfying, the longer it tends to last," or "Behavior patterns between individual persons or groups of people, tend to become adjusted (by trial and miss) toward those which yield the greatest mutual satisfaction." It is implied that the concept of "good" develops in a manner which is dependent upon these more or less satisfying behavior patterns.

This statement was subjected to considerable analysis at the Philadelphia meeting of the American Association for the Advancement of Science in December, 1940. Agreement was general that we had succeeded in the formulation of an objective scientific principle, operative in an ethical manner, but independently of metaphysical implications or considerations. It was also agreed that the principle as stated seems axiomatic. It is inducible from the myriad of examples that exist around us on all sides. Specific case histories of behavior patterns between particular individuals, and factors involved in their constancy or change, are to be found particularly in psychiatric literature. There are a multitude of historical examples of the gradual adjustment toward more mutually satisfying behavior patterns between groups of people. Unfortunately, these have usually involved war. It remains to be determined whether we have the intelligence to utilize more peaceful means. These various examples include the man-wife relationship, the parent-child relationship, the employer-employee relationship, the capital-labor relationship, the master-slave relationship, or relationships between groups of people on a national or racial basis.

It was appreciated that the statement is a special case of the more general principle: "The probability of survival of individual, or groups of, living things increases with the degree with which they harmoniously adjust themselves to each other and their environment." As a corollary of the Darwinian principle of evolution, the formulation thus becomes a biological basis for ethics. It implies the biological value of symbiosis, which is the adaptive biological solution of parasitism. It implies also the culmination of the dynamic interaction of organism and environment in which the surviving organism tends to be the best fitted to the environment surrounding it.

Practically, this symbiotic principle may become as significant in our everyday affairs as has been the case with the formulation of the principle of the conservation of energy, if we will but recognize it. It apparently operates anyway, like the laws of thermodynamics, independently of our opinions about it, whether we like it so or not. As in the case of the principles of energetics, we can apparently function so much better if we will but recognize it and take advantage of it.

There are several important implications which follow from the symbiotic principle as stated. Since satisfaction is a biologically and psychologically significant factor in survival, there will remain the urge on the part of human beings to achieve satisfaction. If then it is appreciated that relationships between humans tend to survive in proportion to the mutual satisfaction derived from them, it is incumbent upon an individual to help make the relationship in which he participates with another individual as satisfying to the other individual as to himself. As long as there is lack of mutual satisfaction, there will be an attempt to adjust relationships between individuals or groups of individuals toward a greater degree of mutual satisfaction. This attempt at adjustment, frequently involving psychiatric aggressiveness or submissiveness, may be relatively violent, as in homicide, including suicide and war!

The implications of the symbiotic principle as stated are in accord with the general ethical exhortations of the centuries. It is irrelevant now to consider the ethical injunctions of the great religious or philosophical leaders as "revealed," since to the modern psychologist, who might be called a "logical positivist," revelation and intuition are little more than logical inductions made so rapidly that the maker is not conscious of the steps in the process, until they are analyzed. These intuitive urgings, such as the "Golden Rule," seem to have been devised in appreci-

ation of the naturally operative ethical principle. However, there is an important distinction. The statement as made in the naturally operative ethical principle is emotionally neutral. It carries with it no exhortations. It simply states what the conditions are under which relationships or behavior patterns between humans survive. It becomes an intellectual matter then to work toward the satisfactions that are to be derived from human relationships in order to establish behavior patterns that will survive.

It might be objected that this development of the harmony theory in ethics will tend eventually to lead to a *status quo*. There seems, however, to be no biological or psychological evidence to indicate that human beings are ever likely to be significantly satisfied for long periods of time no matter what the circumstances may be under which they find themselves. The biological urge towards satisfaction increases apparently from what it feeds upon.

It is felt that the attempt to define a naturally operative ethical principle governing human relationships or behavior patterns is an important contribution to ethicogenesis. The proposed statement is derived from objective and agreed upon biological evidence. While it still lacks the desired precision of formal scientific statements, and while its proof is more indicative than formal, it may be found to have great significance in the regulation of human affairs, if we will take advantage of it. It seems to be a tentative step in a deliberate attempt to establish an ethic on the basis of scientific knowledge and in scientific terms.

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A LOOK AT POSTWAR EMPLOYMENT ADJUSTMENT

By FORREST H. KIRKPATRICK

ANY effort to estimate the size or scope of peacetime employment problems may seem like meaningless labor, because there are so many variables. But it seems clear that personnel men will find themselves faced with occupational adjustment problems of considerable magnitude. There is disagreement and uncertainty, of course, as to the extent of possible unemployment and dislocation. Estimates of unemployment have run as low as one million and as high as fifteen million. These conflicting estimates are bewildering but they seem clearer when we realize the "postwar period" will have many phases. There will be a period after "V–E" day, another after "V–J" day, and then the full swing into peacetime economy. This "period" will cover years—not months.

In April 1940 (which we can take as a benchmark), there were about fifty-four million men and women in the labor force, including forty-five and one-half million employed persons, about eight million unemployed, and less than one-half million in the Armed Forces. Four years later (in April 1944), the total labor force had expanded by more than nine million to sixty-three million. Civilian employment was above fifty-one million—about six million above the April 1940 figure. The unemployed had decreased by seven million, and the Armed Forces had increased by ten and one-half million.

Our ability to expand the labor force by nine million explains much of the success of our war mobilization. This represents a growth of six million to seven million over and above the increase which normally might have been expected to occur during four years as a result of population growth. Three million of the so-called abnormal increment to the wartime labor force have been women—about one and one-half million under twenty-four years of age and about one and one-half million over thirty-five years.

Where do we have to set our sights for the postwar period? It is certain that many older workers will wish to retire, that many women will prefer to resume their work as homemakers, and that we shall once again start to raise the school-leaving age. Thus we need not visualize sixty million persons in the postwar labor force. It is necessary, however, for us to visualize a much larger force than we had in 1940, first because of population growth and second because of residual influences of the wartime expansion.

It it highly improbable that abnormal wartime influences on the labor force will vanish without leaving any trace. But let us say that conditions are such that only fifty-eight and one-half million people are at work, or in the Armed Forces, or seeking work in 1947. There will be, perhaps, two and one-half million persons in the Armed Forces. If we grant that two and one-half million is a maximum volume of permissible unemployment, we are faced with a need for fifty-three and one-half million civilian jobs. This is seven million more than in November 1940, and three million above November 1941 (just prior to Pearl Harbor). These figures suggest the magnitude of the postwar problem, particularly if we recall two facts: (1) the vast expansion of certain war industries, and (2) that most non-munitions industries except construction have expanded rather than contracted during the war.

Various organizations have made forecasts with a good deal of agreement as to the expected level of employment in the post-conversion period. These estimates range between forty-nine and fifty-two million in agricultural and non-agricultural employment two years after the end of the war. In other words, the very best of the expectations (fifty-two million) runs considerably under the lowest possible forecast of needed jobs (fifty-three and one-half million), and at least three million under a reasonable forecast of need. Some of the estimates run three million below this level.

If we arbitrarily take a figure of fifty million jobs as an assumed figure that corresponds to our current sighting, what does this mean? It means a net movement of about four million out of manufacturing industries. These will have to be moved out of iron and steel, machinery, aircraft, shipbuilding, non-ferrous metals and chemicals industries. A few hundred thousand additional workers may be absorbed in furniture, textiles, leather goods, paper, and similar industries. Employment in such non-manufacturing industries as construction, trade, finance, and services will expand after the war but hardly enough to offset the contraction in manufacturing industries.

The main problem of unemployment, of course, will arise when war production is virtually eliminated with the termination of hostilities in Japan. The measures instituted after the defeat of Germany, however, will substantially affect the magnitude of the unemployment problem in the later period. Such measures may also determine a pattern for business, labor, and government to follow subsequently. If the government provides finances for educational opportunities, if it increases old age insurance, if it liberalizes income tax reductions for dependents permitting more women to return to the home, unemployment in a part of the postwar period will be materially reduced.

In discussions of postwar unemployment too little attention has been directed to the fact that the demobilization of the war economy will fall with varying impacts upon different regions of the country. A recent Cleveland Trust Company Bulletin shows the number of war workers and members of the Armed Forces who will be demobilized in each of eighteen states. It is estimated that five million, four hundred thousand war workers and eight million, eight hundred thousand members of the Armed Forces will have to be demobilized. About half of this total will be located in seven states: New York, California, Pennsylvania, Ohio, Illinois, Michigan, and New Jersey. The National Industrial Conference Board has also made available some illuminating data on this point, based on recent studies.

In some states, such as California and Michigan, the major problem will be unemployed war workers. In other states, such as New York and Pennsylvania, the major problem will be the reabsorption of returning service men. New manufacturing areas, such as California, will face problems different from those (such as Michigan), which have long been important manufacturing centers.

After the last war there were areas in England which became known as distressed, or "blighted," areas. When our wartime boom is ended a similar problem will arise here. Towns which have mushroomed under the stimulus of nearby war factories, or the nearby location of cantonments, will face the painful process of contraction and readjustment. While over-all programs to reduce unemployment may be useful in limiting the magnitude of the problem, they will not solve the problems of particular areas. For such areas special measures will be required. Initially, it would be desirable in connection with contract termination if, in such areas, plants which cannot be converted were to continue to produce war goods, while those in more favorably located areas in terms of employment opportunities receive the first cutbacks in orders.

In the years just ahead, personnel men in industry will be called upon to help with the guidance and adjustment of thousands of workers. More adequate vocational guidance facilities for adults should be provided as we prepare for peacetime employment. Much needs to be done toward getting ready to do this job properly. Communities, industries, schools and social agencies must be ready to carry their share of the load. Well-trained guidance counselors are needed. Such psychological implements as are available will be used, but we cannot hope that aptitude tests and clinical techniques are sufficient. Better information about specific jobs is badly needed. This calls for job analysis, job specifications, and techniques for appraisal of skills and temperament required in such jobs. Then, too, we need more information about the occupational outlook in terms of community areas, types of industries, and seasonal variations.

The guidance and placement of men and

women from the Armed Forces will present some unusual and difficult situations. In general, the men who will return from military service can be divided into four groups:

(1) The first group includes the physically disabled. Observations made by placement agencies reveal that fairly widespread objection still exists to the employment of disabled individuals. Often little consideration is given to true capabilities.

(2) The second includes men who want to and are physically qualified to go back to their old jobs. This group includes men who have not acquired any new skills in the military services and others who, despite the acquisition of new skills, prefer their old jobs.

(3) The third group consists of men who have received technical training or whose war experience has created dissatisfaction with pre-induction jobs and an expectation of placement in better or more responsible jobs. This group includes the office boy who has been piloting a four-motor bomber; the mechanic's helper who has acquired the rating of technical sergeant and has been responsible for the repair of bombsights; and the engineering apprentice who has become a commissioned officer or a radar operator.

(4) The fourth group is made up of the young men in the Armed Forces who never held a job before they went into the Army or Navy. They have little or no understanding of business and industrial operations. Yet they have had a varied and active service experience in which life has been lived intensely in some instances and very drably in other instances. The routine and, ofttimes, uninteresting demands of a business or industrial job may be irritating.

Any program of guidance and job placement should be built in terms of providing honest, realistic, and helpful treatment—taking into account the innumerable human, technical, economic, and political elements involved. It should represent a consistent, effective, and continuing program and not a "patriotic spree" of short duration and little import. Large numbers of workers and veterans will have to be guided to the industries and localities offering more favorable opportunities, either through the U. S. Employment Service or through the state employment agencies when that function is turned back to the states.

Vocational guidance for the individual as he faces the future must be done in rather specific terms. General information about new developments in plastics, possibilities of airline freight, and machine tool industries for India does not offer help to the man or woman who is released from the Armed Forces or from a war plant. Such persons need specific help as to appropriate job opportunities, available training facilities, and the resources of community, industry, or government that may be utilized at once.

The reorganization of our economy to peacetime pursuits will present tremendous difficulties. Regional dislocations, unavoidable lags in reconversion, demobilization of war workers and members of the Armed Forces and surplus property disposal are among the problems which will complicate the readjustment process. The attainment of the desired new record levels of production of peacetime goods will be extremely difficult, if not impossible, under the conditions prevailing during the transition period.

It would be more realistic to make allowance for the time which will be required to make the necessary adjustments to achieve these goals. Output increases aggregating more than fifty percent cannot be achieved overnight. Time will be required to gear our productive and distributive mechanisms to this new level of activity. Unless we have a full appreciation of the magnitude of the task before us, the attainment of these goals will be made difficult because we failed to get ready—making and implementing plans and objectives.

ARGENTINA'S AGRICULTURAL FUTURE

By J. A. SHELLENBERGER

ARGENTINA has attained world renown as an agricultural nation. This reputation has been based principally on the quantity and high quality of her meat and grain exports, which result from a combination of conditions, including favorable climate, fertile soil, and a limited population. Argentina has been able to produce foodstuffs far beyond her own domestic requirements, and every indication is that this condition will prevail for some time to come. Her fame as an exporter of agricultural materials will probably increase rather than diminish during the next decade.

In the past, abundant and relatively easy production of meat and cereals in certain limited and favorable areas has led to the common misconception that Argentina is a land of unequaled agricultural opportunity for an increased population. There is too frequently a lack of understanding both within and without the country regarding the political, economic, and social conditions that characterize Argentina's agricultural development. One of the most prevalent erroneous contentions is that Argentina is a country of vast undeveloped agricultural resources and that good land in abundance awaits only the arrival of ambitious settlers. The origin of this concept is probably traceable to circumstances existing before the last great division of public lands during the middle of the nineteenth century. Recurring colonization propaganda has spread the idea that Argentina is a land of promise for settlers seeking an opportunity of putting additional land under cultivation. This concept has been repeated so frequently that many Argentines believe in the practicability of rapid agricultural developments.

It is not generally recognized, even in Argentina, that practically all the land suitable for agriculture is already in use. In other words, the country is fully developed in respect to the type of argicultural system prevailing. This statement does not deny that there exists a great opportunity for fundamental changes to alter entirely the present land utilization system, but the situation now is that the land that has made Argentina famous for pastoral and agricultural products is fully occupied. The implication is not that the full possibilities of the country have been realized, but that alterations in the type of agriculture in a given area are fundamentally different from the opening up of new lands.

For example, a diversified farming can be practiced on the pastureland now utilized for beef production. This would bring about many social and economic changes. However, if we consider the subject entirely from a land utilization standpoint, the substitution of cultivated crops for pasture is merely shifting the type of land utilization. Obviously land may be as fully utilized for pasture as for any other purpose. Moreover, even the development of diversified farming cannot be expected to proceed rapidly, because most of the land is held in large estates and is thus not available in small units such as are required for intensive cultivation. Good land is seldom offered for sale; consequently families wishing to farm are forced to become tenant farmers.

Argentina is a country of large landholdings, and the small farmer, unfortunately, is a comparatively insignificant factor both politically and from the standpoint of agricultural production. Over the country as a whole, approximately 40 per cent of the land is held in estates of more than 12,000 acres. Land ownership in Argentina is synonymous with wealth and social position, but unfortunately over 80 per cent of the people who work the farms are not landowners. The system of landholding by a privileged few is a fundamental Latin American tradition dating back to the days of the Spanish Conquest. As new land was discovered it was divided up into huge units for distribution to faithful followers, and later, after the wars that won independence from Spain, the same land-allotment process was repeated in most of the South American countries. The land has always been held

firmly by the ruling caste or their governments. In contrast to the settlement of the North American Continent, immigrants to Argentina have found that there was no good land to spare for them.

The immigrants who arrived in Argentina during the latter part of the eighteenth and the beginning of the nineteenth century became the peons, or laborers, who now work the soil as tenant farmers. This is the result of the organization of the large estates where the owner engages in beef-cattle production to the exclusion of other farm activities, on as much of the land as can conveniently be managed, but leases small tracts to tenant farmers for cultivation on a share-crop basis. Most of the cereal and dairy production of the country, for example, is in the hands of share-crop farmers. However, much of the very best land remains in pasture for beef-cattle raising. If this pasture-land were intensely farmed, a vastly different social and economic system would result, but the critical consideration now is the realization that the land of Argentina is fully utilized when it provides pasture for stock up to the maximum capacity to support the animals.

There is always speculation regarding when and how the present agricultural system will change to provide a more equable distribution of the wealth of the land. Insofar as the most valuable land in the littoral area is concerned, there is no immediate hope for any startling changes. The position of the landowner, tenant farmer, and farm employee and the type of agricultural production appear to be sufficiently firmly established to resist change except perhaps for certain minor adaptations of crops as market conditions change.

The area that represents Argentina's principal agricultural wealth is the flat, fertile, and adequately watered littoral region, which includes the provinces of Buenos Aires, Santa Fé, Entre Ríos, and Corrientes. Nature has provided in this area one of the world's most favorable combinations of soil and climate. The essential foundation for profitable agricultural enterprise in this area has been recognized and fully utilized for the past 150 years, and that is why this land is tenaciously held in large estates. There is practically no opportunity under present conditions for the adequate support of a larger rural population based upon more intensive farming practices.

There are several other cultivated zones outside the littoral area, such as portions of the provinces of Tucumán, Salta, Mendoza San Juan and the territories of Río Negro and Chubut where intensive agriculture is practiced. With the exception of the provinces of Tucumán and Salta, the principal sugarcane-growing areas, the other regions mentioned produce fruits, grapes, vegetables, and other crops that can be profitably grown by intensive cultivation on rather small farms under irrigation. In these areas the extent of land cultivated is largely limited by the availability of irrigation water. However, it is erroneous to suppose that uncultivated land is unproductive land, because from the tip of Patagonia to the Bolivian border and from the swampy and inundated stretches of the Paraná River system to the high slopes of the Andean Mountains, cattle, sheep, and goats are pastured. Families even eke out a precarious living on submarginal land by pasturing sheep or goats on rough, dry, barren terrain, and not infrequently neither the families nor the animals are adequately nourished.

The people live under conditions of extreme deprivation, but conditions are no better for the families attempting to make a living on the damp, swampy, and frequently flooded areas of the Paraná and Paraguay Rivers. Even though cattle learn to swim and forage among the islands or to eat vegetation as it floats down the river channels, life is difficult and the rewards are small for the persons who thus strive for a living by raising cattle under such circumstances. Truly, Argentina is not the land of agricultural opportunity that many people visualize.

There are, it is true, vast areas in Argentina that can be made more productive at a *price*. Swamps can be drained; irrigation projects can be completed to supply water to arid regions; land can be cleared of trees, bush, or rocks; and transportation to markets can be provided for the movement of produce from what are now inaccessible localities. All these measures require large expenditures that are somewhat difficult to

finance. Obviously Argentina has no monopoly on land that can be made productive at a price, for such areas exist in every country of the world. The financing, planning, engineering, and construction required in Argentina to put certain areas under cultivation would, if similarly applied, produce equivalent or possibly even greater returns elsewhere. Argentina loses her tremendous economic advantage on agricultural export commodities whenever products are produced on land that requires more than the minimum of labor and materials.

Consider first Patagonia, or the southern portion of Argentina below the Río Negro. Here a very difficult land utilization problem is presented. However, in the opinion of many qualified persons the land in this area is at present effectively used for sheep raising. As a whole the region does not support many sheep per unit area, but for the present at least this appears to be the best use to which the land can be put. It is conceivable that years of careful selection and breeding experiments plus the application of scientific agricultural methods will eventually yield forage plants that will provide better pasture and diversified crops.

There are adverse weather conditions to combat. The warmer ocean currents sweeping the South American coast tend to cause the cool air from the Andean range and the high plateau to rise after reaching the ocean. There is thus created a continuous directional wind that blows at times with terrific velocity from west to east across the entire southern portions of Argentina. Thus, strong and almost continuous winds necessitate the use of windbreaks before the topsoil is plowed. Usually rows of trees are grown to serve as protection against wind erosion. This type of erosion is a serious fundamental handicap to extensive cultivation even if all other factors essential to farming were satisfactory. But there are other difficulties. For example, the average precipitation for the entire area is about 10 inches annually, and this is insufficient moisture for most crops, since even wheat requires about 15 inches. Except for a section of the Chubut Valley there are no irrigation works, and even here unwise use of water is fast making the soil unproductive.

In the face of the physical difficulties confronting agriculture in the southern territories, it appears that Patagonia will remain for some time a land of large landholdings devoted principally to sheep raising.

Irrigation can be expected to bring about eventually an expansion in land cultivation in the provinces of La Rioja, Catamarca, Santiago del Estero, Salta, and Jujuy. However, there are many difficulties to be overcome, since there appears to be no practical means at present for obtaining sufficient water for the entire region. Rains are infrequent, and these regions are hot and dry. The Andes Mountains receive some snow because of their great height, but there are no extensive glacier or snow fields in the north to provide a continuous run-off of water during the summer months. Consequently water must be conserved by the building of dams, and this will be a costly undertaking for a sparsely populated area. There is not much agitation for such projects, since most of the land is owned by a relatively few persons, and they receive more than adequate incomes from the animals that now graze the land.

One irrigation project that is frequently talked about and that may be practical is the construction of a canal designed to carry a portion of the waters of the Paraná and Pilcomayo Rivers down the Río Dulce Channel. If this project is feasible it would bring much needed water to the provinces of Salta and Santiago del Estero. On the assumption that there would be a rational land-development system and the adoption of just "water rights," this project would make available large areas of fertile land for development.

To illustrate the lack of opportunity in some of the semiarid northern country, consider the case of the city of Catamarca, which is the capital of the province of the same name. It is estimated that approximately 65 per cent of the entire population are employed by some governmental agency and are working in either the Federal or Provincial administration offices or as teachers, soldiers, and police, or on governmental railroads, highways, or irrigation projects. Because of the lack of other enterprise the population is largely dependent upon some form of gov-

ernment employment. Here is an example of the reverse sequence of events from the precedent established during the development of the United States where usually agricultural and business enterprise sprang up and governmental activities gradually followed as needed by the community. A top-heavy preponderance of governmental employees is not, at least under some conditions, the most desirable social and economic structure upon which to build a community.

Various private and governmental colonization schemes have been undertaken in the northern territories of Formosa, Chaco, and Misiones. Most of this territory was originally forested, and large areas still are uncut. In the Chaco and Formosa the *quebracho*-extraction industry has resulted in the deforestation of large areas, and land companies are now anxious to persuade settlers to occupy portions of this land. Plots have been sectioned-off into small units and are offered for sale. However, the small size of the farm units and the conditions of the purchase contracts are such that there is not much appeal to the few families possessing some funds and a willingness to face the toil and rigor of pioneer life. Most of the colonists in the Chaco are growing cotton, but it is difficult to make this a paying crop, especially on small farms. Inadequate transportation to centers of population makes the growing of semitropical fruits and vegetables unprofitable. In spite of many difficulties and innumerable handicaps, agricultural progress is being made in the Chaco, and as more and more land is cleared further developments will follow.

The territory of Misiones has many natural advantages that may in time lead to its full agricultural development, but colonization up to the present time has been made only after many failures. Most of the first settlers have spent their labor without gaining either a home or ownership of even a small piece of land. However, there are now several flourishing settlements along the Paraná River, and in addition to the lumbering and *yerba-maté** enterprises many different crops ranging from jute and hemp to soybeans are being grown on an experimental basis to determine their probable suitability and profitableness. The most profitable crop has been *yerba maté,* but legislation designed to maintain prices and prevent the accumulation of surpluses has resulted in a law that now prohibits the establishment of new plantations or the extension of those now in production.

The future will undoubtedly bring many changes in the northern regions as sanitary conditions improve and as safeguards of public health and welfare increase. Also, better education and fuller social life are needed to entice desirable families into the areas. Except for portions of Misiones, the three territories of Formosa, Chaco, and Misiones contain a large proportion of low swampy land most of which is forested. There is probably no more reason to expect rapid development in these regions than in other similar semitropical areas of which there are many in South America.

It is probably safe to conclude that over the entire country the amount of land under cultivation, the type of crops, and the general methods of agriculture will continue more or less unchanged during the immediate postwar period. New land placed under cultivation in the next few years can be expected to keep pace with the food and feed demands created by the country's normal increase in population, but there is slight likelihood of an increase in exportable agricultural products resulting from new land developments. What immigration trends will be at the end of the war is problematical, but Argentina is not likely to be swamped with applicants, and those European refugees who gain admittance will find industrial employment preferable to farming. Already the population shift in Argentina has been toward the industrialized cities. If only a portion of the country's present industries can be profitably operated during the postwar period, there will be but small incentive for families to undertake the arduous tasks of earning a living by developing new farms. Argentina cannot under present conditions be considered as the land of agricultural opportunity except for those who already own the land.

* The leaves and small stems of the *maté* plant are used in South America to prepare a beverage frequently referred to as Paraguayan tea.

THE SAVAGE SERIS OF SONORA—II*

By EDWARD H. DAVIS AND E. YALE DAWSON

AFTER the Seris' first contact with the invading white man through Coronado's soldiers in 1540, they lived for nearly another century outside the influence of the civilization that was eventually to engulf them. By the early 17th century, however, pearls were discovered in the Gulf and the sailing ships that began to ply the waters introduced the first great innovation into Seri culture. The Indians found on their beaches boards from these ships and, most important, flotsam hoop-iron and nails. One of the great difficulties in constructing arrows and harpoons had been the fashioning of the point. The stone, tooth, or bone points were difficult to make and more difficult to attach securely to the shaft. The more easily worked iron proved a boon to their hunting and fishing, and later made a more satisfactory weapon of war than they had hitherto possessed.

The beginning of Seri wars was the year 1700 during which they first conducted nocturnal raids on some of the most outlying of the Jesuit mission pueblos of Sonora, killing inhabitants with their arrows and stealing the cattle and horses. Year after year, the gradual expansion of Sonoran settlements and their nearer approach to the borders of the Seri homeland aggravated the conditions of conflict. The vigorous proselyting expeditions of the Jesuit missionaries brought about the capture of some hundred women, children, cripples and vieilards of the Seris, and concurrently the death of many defending warriors. These expeditions further kindled the hatred of the free Seri against the white man, while the few score "converts" gathered about the several missions gained a shocking character for sloth, filth, thievery, treachery, obstinacy and drunkenness. Raids upon the settlements continued and between 1757 and 1763 4,000 mules, mares and horses were known to have been stolen and eaten.

FIG. 13. PREPARING BASKETRY MATERIAL

THE SPLINTS ARE MADE BY HAND AND MOUTH STRIPPING OF THE BRANCHES OF TOROTE AND PALO BLANCO.

* Continued from page 202 of preceding issue.

FIG. 14. JUAN TOMAS AND NEPHEW
OLD SERI CHIEF BEFORE CHICO ROMERO AND VETERAN OF MANY WARS, IN 1926 AT THE AGE OF 94 YEARS.

The further extension of settlements necessitated the establishment of military posts from which troops were sent out, first by one, then another governor of Sonora, to destroy all Seris they might find and to discourage their wanton looting and killing. If a strong force was sent out, it was frequently ambushed and many soldiers were left on the field, transfixed by arrows. Many small forces left never to be heard from again. In 1780 an army of national troops met the Seris in several bloody battles in their Cerro Prieto, and claimed to have exterminated the tribe. Yet the Indians retained sufficient vitality to continue their sanguinary raids on the settlements of Sonora. Many expeditions, fitted out at great expense, were sent against them, but in that barren land, destitute of water, the military parties suffered greatly in their campaigns, and succeeded little in their efforts to conquer the wary natives.

By 1850 probably every Seri between infancy and decrepitude had seen the proprietor and other inhabitants of the rancho of Don Pascual Encinas at Costa Rica where the Seris were abnormally tolerated and even encouraged to make themselves useful and unobjectionable. They yielded to indolent scavengering more than ever before; they substituted cast-off rags and barter-bought cotton cloth for their pelican robes and other primitive garments. They ate cooked food when it fell their way; half heartedly they adopted metal cutting implements and sought or stole nails and hoop-iron for arrow points. Some acquired a smattering of Spanish and many came to sport Spanish names. Never, however, did more than one or two Seris come to live in a house, nor even to encompass the idea of making adobe. They had not learned to ride horses nor to burden them, but only to use them for immediate slaughter and consumption. They were acquainted with firearms, but it was not until years later that they learned to use them. In and about Rancho Costa Rica the Seris and the Mexicans lived for a time in mutual tolerance, certain depredations being allowed the Indians just as were the rodents of the rancheria.

When, in 1855, Don Pascual Encinas experienced the loss of unusually large numbers of stock from Seri raids, he was aroused into announcing that a Seri head would be taken for each head of stock stolen. For a while the Indians seemed to acquiesce, but within a few days a group of Seri women "milled" a band of horses, caught and threw one so that its neck was broken, whereupon they immediately sucked its blood, gorged on its intestines, and buried its quarters to "ripen" according to their custom. The vaqueros of the settlement were instructed to shoot the first Seri seen on the llano. Within two days the tribe was on the war-path and the war raged for a decade.

The Encinas war reduced the tribe to some 350 people, and temporarily discouraged their bloodthirsty raids. By 1893, however, new killings were being reported. In one instance the Seri Chief, Juan Tomas (Fig. 14), watched as the men of a large rancho left for a rodeo and then, worming up through the brush, led his warriors into the buildings and with clubs and arrows massacred every woman and child within. Two Yaqui women who had managed to escape into the brush watched as the warriors seized the infants by their feet and dashed their brains out against a large rock near the corral.

In 1904 a number of wilder Seri, led by several Yaquis, went on the warpath and killed every soul in a Papago village. The war with the Papagos that ensued aroused the Governor of Sonora into action. Nearly 250 armed men were sent out to kill or capture the Yaqui leaders and to administer a severe lesson to the Seris. The desert water holes were all placed under guard until the Seri chief, Juan Tomas, was forced to surrender for his thirsting tribesmen. Peace was conditional on the delivery of the Yaqui leaders with their hands tied together. Two days later a couple of gaunt, wild-looking Seri women, clothed in rags and with painted faces, walked into the camp to keep the conditions of the peace as they had understood them. They carried a palanca between them from which were suspended bundles of severed hands of the Yaquis who had been clubbed to death as they slept.

Twenty years after the delivery of the Yaqui hands (1922) the senior author, under arrangement with the Museum of the American Indian in New York, carried out his first expedition into the heart of Seriland. Although still intolerant of aliens and at times dangerous if aggravated, their depredations had been reduced to the occasional killing of a stray cow. The Seris had come to live a comparatively peaceful life under the supervision of Roberto Thomson of Hermosillo. It was through his efforts that the Seris were saved from complete extermination by the vaqueros of Sonora, and after having treated them for many years as a friend and adviser, he had made it feasible for a visitor to enter their lands and to live among them without undue fear of losing his life. Through the kindness of Señor Thomson the senior author succeeded in making himself a friend of the Seri and, enlarging upon this friendship through long periods of living and traveling among them, has acquired an intimate knowledge of these strange people.

In 1922 the fishing industry of the Gulf of California was not yet well developed, and it was to be ten years before the village of Kino should appear on the maps of the Sonora coast. The Seris were still isolated in their desert domain and their numbers, then about 250, were maintaining themselves out of reach of the infectious diseases of the white man. The clan life had disappeared, and the people lived as a single tribe with their old chief, Juan Tomas, 90 years old at that time

FIG. 15. MOVING DAY AMONG THE SERIS
THESE BURDENS, BORNE FOR MANY MILES OVER ROCKS, THROUGH CACTUS AND DEEP SAND, CONTAIN UTENSILS FOR HOUSEKEEPING WHEREVER THE SERIS MAY STOP.

and a veteran of nearly a century of warfare against the soldiers of Sonora. The turtle remained their most important source of food, and the pitahaya harvest the most enjoyed. The crafts of their old culture were largely gone, however. Hoop-iron had come in for many uses: harpoon points, scrapers, and knives. The bow and arrow had been almost entirely supplanted by rifles of which the tribe possessed more than thirty. The handmade olla was fast disappearing in favor of the five-gallon tin can, and water carrying, now much done by the males, was accomplished by means of a palanca, borne on the heavily calloused shoulder, to which a can was suspended from each end.

It seemed that the balsa building art was encountered barely as it passed into extinction, for the last balsa known to have been made by the Seris was found in use near Kino, in 1922. This rare prize was immediately bargained for and in exchange it was agreed that the tribesman should have lumber to build a boat large enough for all the people of his family. A few months later the finished craft, caulked with a "pitch" made of sea lion oil and powdered cactus skeleton, was launched. It was the largest craft they had ever possessed and came to be called the "battleship," for its size.

After having established firm friendship with the tribe in 1922, it was possible two years later to carry out an extensive plan to learn the habits of the Seris by living among them, sharing their comradeship along with their privations. At this time they still had no homes that could even be called semi-permanent. Moving here and there in response to fluctuations of their precarious food supply, household things were not accumulated, and life continued to be reduced to its very simplest elements and absolute necessities. Baskets made of fiber from the torote tree, some tin cooking and water vessels (the handmade olla was seldom any longer made), some patched and filthy rags which served as blankets to the fortunate few, constituted the family possessions (Fig. 15). Starved, bony family dogs were abundant, as always, every Indian having one or two (Fig. 16). Each day they could be seen gnawing on some old fish head long since

FIG. 16. FAMILY DOGS ARE OFTEN MORE NUMEROUS THAN THE PEOPLE
HERE A GROUP OF SEVEN SERIS IN THE VILLAGE NEAR KINO KEEPS TEN OR MORE OF THE MONGREL CANINES.

FIG. 17. SERI BLIND MAN
BEING LED BY A BOY. NOTE THE CRUDE SHELTER OF POLES AND BRUSH SERVING AS AN AIRY DWELLING.

destitute of nourishment, tough and strong as rawhide; but hope springs eternal in an Indian dog's stomach, and again and again he will search out and mouth the same old pelican bone or fish head, discouraged never. The dogs, beside keeping the camp clean, lick all the cooking utensils when they are not tended, and also are allowed to lick clean the infants after they have performed their natural defecations. A Seri girl was seen placing a small can of water for a dog to drink from, afterward drinking some of the remainder herself and then pouring the rest back into the family five-gallon can.

Although the conditions of existence for the Seris had from time immemorial been too precarious to permit of anyone living who was unable by physical disability to hunt or fish to get his meat, there were two or three men, blind or nearly so, whose wives got an uncertain living for them by the hardest struggle (Fig. 17). If a Seri, however, became ill of a disease which the tribe feared, he was often taken into the desert and left with a little food and water, either to get well and return or to perish.

Sea turtle was still the staple meat, and with better boats and improved tools and tackle borrowed from the Mexicans, the living was becoming considerably less harsh along the shores. They then had nine boats for some two hundred people. One good boat could secure a living for five families, and they had well improved this minimum standard of living.

The origin of the use of fire among the Seri's is unknown, but they have their own story of it. One day Chico Romero, present chief of the Seris (Fig. 19), made a fire drill out of a piece of dry driftwood and showed how to make a fire by turning the stick between the hands. In three or four minutes the fine dust became a glowing punk which, with the aid of some dry grass and the wind, was quickly fanned into a flame. He was then induced to tell the legend. He looked about and pointed to a little green and blue-bodied fly and said: "The gods sent this fly down from the sky to show us how to make fire. Notice when it lands. Did you not see

FIG. 18. THE NATIVE DANCE
IS DONE ON TOP OF A TURTLE SHELL TO THE BEAT OF A BOW STRING BEING STRUCK WHILE THE BOW IS HELD AGAINST TWO INVERTED BASKETS ON SAND.

it take its two hands, rub them over its head and then rub them together a few times? The Indians noticed this and in this way we were taught by this little fly how to make fire by rubbing a stick back and forth between our two hands."

In response to comments about the nocturnal howling of the coyote, Chico told another interesting tribal legend. "A long time ago all Seris were birds or animals. The badger had charge of the saints or gods, which were little images carried in a pouch and hung around his neck by black strings.

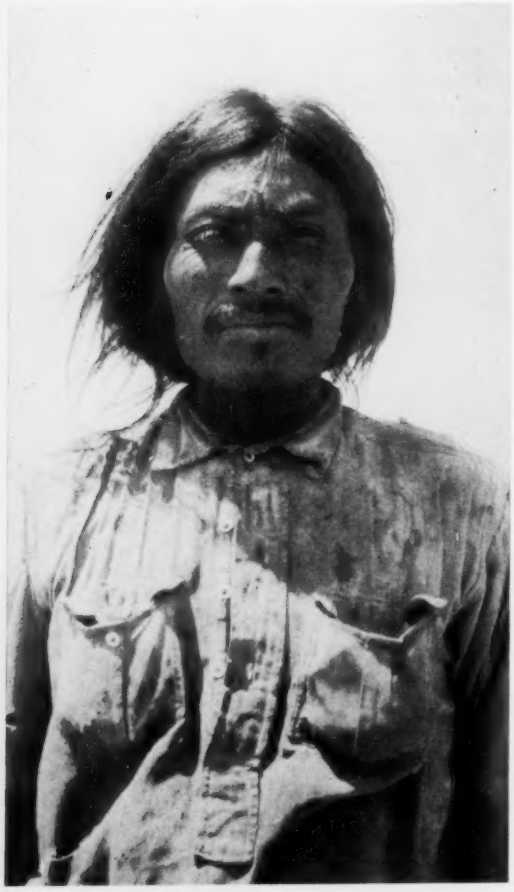


FIG. 19. CHICO ROMERO
WHO SUCCEEDED OLD JUAN TOMAS AS CHIEF OF SERIS.

Coyote got to quarreling with badger and, watching his chance, grabbed the bag, tore it loose and ran off with it, giving his derisive laugh as he ran, and ever since coyote has been laughing at badger and all others. Before this it was day all the time, but then it became night and coyote only laughs at night. The black strings still hang about badger's neck."

It is strange to find, too, that a flood legend is traditional among the Seris. Chico said: "In the times of the ancients a great flood came, the ocean rose up and all the country of the Seris was under water except the top of Cerro Alto. There a few Seris gathered and were saved. Everyone else was drowned. To this day the top of Cerro Alto is covered with brush which the flood did not submerge. All Seri children are taught this flood tradition, and they must learn it by heart so as to teach their children and their grandchildren."

The death of a tribesman gives no cause for ceremony among the Seris, although the nearest relatives may customarily wail, sometimes for months, morning and evening. The disposal of the bodies of the dead, is, however, of considerable interest. A hole about three feet deep is dug by means of large clam shells and a cave is excavated for the head such that the earth will not touch it. The deceased Indian is wrapped in his own blanket and laid in the grave with the head to the East, face up. The body is covered and the grave is partly filled with earth, then covered with a layer of the spiniest of chollas and thorny brush, further filled, leveled and covered with another layer of chollas to discourage the coyotes from digging up the body. When the Seris are on the move, however, and grave-digging is too great a task, a body may simply be lifted high to the fork of a giant cactus and left there.

Marriage among the Seris is not so much a ceremony as it is the completion of a bargain. Under ordinary circumstances, when a man buys a woman he strikes a bargain with the bride's parents and makes a down payment. Only after completion of the bargain does the woman go to live with the man, but even then payments do not cease but continue intermittently through life. Chico Romero, although "married" for fifteen years, gave his wife's father some paint that he had received in payment for guiding and packing. It is also considered natural to buy and sell children. One Seri, Santo

FIG. 20. SERI WOMEN BEARING FIRE WOOD TO THE CAMP AT KINO

Blanco, whose son was only sixteen years old, bought outright for him a little girl of six years.

When contracts for fish were secured by the Mexicans from American markets in about 1932–3, the exploitation of the teeming waters of the Gulf was rapid, and the village of Kino suddenly appeared on the bay by that name where there had been nothing but Seri jacals before. Today there

FIG. 21. A MEXICAN TOTUAVA CATCH ON THE BEACH AT KINO

FIG. 22. SOME SERI WOMEN OF THE VILLAGE NEAR KINO

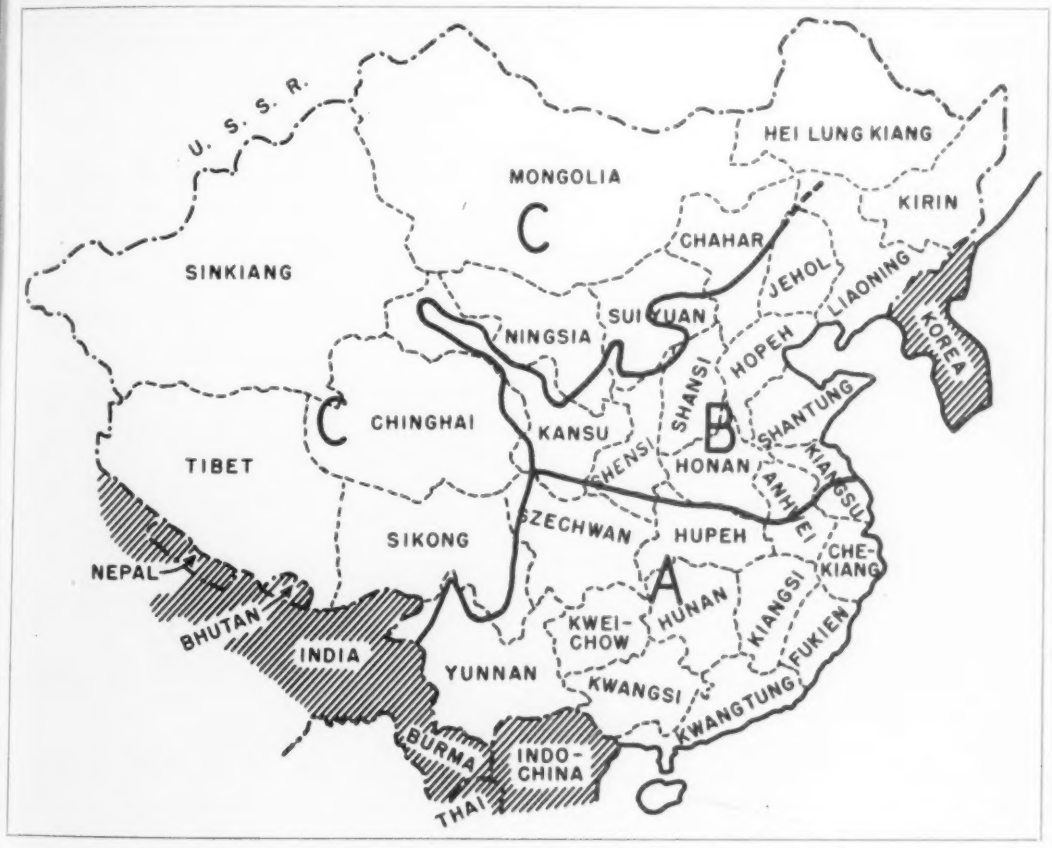
are four or five hundred people there, more during the peak of the season, and some fifty or more wattle and daub shacks arranged without plan or order, facing at every angle, but all near the beach on which the fishing boats land and are pulled up on shore. Refrigerated trucks carry fifteen to twenty-five tons of fish away daily during the height of the season, mostly the huge endemic totuava (Fig. 21). These great fish are dragged from the boats and lined up on the shore, where the heads are chopped off and the entrails are pulled out and left to be carried away by the tides or consumed by hundreds of scavenger gulls of the beach. A quarter mile north of Kino is the present-day Seri village where nearly all the Seris now live semi-permanently because of the easy money and living. They have their own boats, fish a little for profit, and also bake the discarded fish heads for food. The Seri dwellings are now scarcely inferior to many of the wattle and daub shacks of the Mexicans. Indeed, many of the Mexican shacks are built by Seris in exchange for manta cloth or food. They are mostly of ocotillo sticks and mesquite branches stood up in the sand, lashed together, and plastered with mud for protection from the wind, but not from the rain (Fig. 22). When the fishing season ends about Holy Week, they all move away to the turtle grounds on Tiburon Island, where they also hunt deer. Then in June and July they go into the desert hills to reap the harvest of cactus fruit, retiring to the lowlands thereafter to harvest the mesquite beans and to await the recurrence of the big fish. In and about Kino they are reasonably well fed and clothed, and were it not for their susceptibility to disease they would be as well-off as many of the Mexicans. Influenza strikes them heavily, however, and pneumonia is common, usually fatal. Their numbers dwindle and their extinction is in sight, yet for a little while these strange people will continue to tread the rocks and thorns of their desert land, a handful of Nature's primitive creatures, through whose veins flows the blood of thoroughbred American aborigines.

LIVESTOCK IN THE LIVES OF THE CHINESE

By RALPH W. PHILLIPS

THE place of livestock in the lives of the people of any country is related intimately to their mode of living. The mode of living in turn is closely associated with geographic and climatic conditions. In China there is a wide variety of these conditions, and there are two main modes of living among the rural populations, represented by the settled farmers of the eastern and southeastern parts of the country and the nomadic and seminomadic peoples of the northern, western, and northwestern portions. In addition to variations in mode of living of the people and in the environment, there are variations in racial stocks that affect the utilization of livestock.

China is a land of mountains. Level land is found only along some river valleys, in delta regions, and in a few other areas. The largest of these level areas is the compound delta that reaches from northern Chekiang Province northward into Manchuria. There are two large inland basins in Kiangsi and Hunan Provinces, around Poyang and Tungting Lakes, respectively. There are a few alluvial areas south of the Yangtze Valley, including small deltas in the vicinity of Swatow and Canton. West China has



THE MAJOR AGRICULTURAL AREAS OF CHINA

Area A IS THE RICE REGION. *Area B* IS A RELATIVELY DRY FARMING REGION WHERE WHEAT IS THE MAJOR CROP; MILLET AND KAOLIANG ARE ALSO IMPORTANT GRAIN CROPS IN PARTS OF THIS AREA. *Area C* IS PREDOMINANTLY GRAZING LAND; THERE ARE WIDE VARIATIONS IN GEOGRAPHICAL AND CLIMATIC CONDITIONS HERE.

HIGH FARMLAND IN EASTERN CHINGHAI
ALTHOUGH THE MOUNTAIN IS TERRACED TO THE VERY TOP, EROSIVE GULLIES ARE FORMING AS SHOWN HERE.

limited level areas in the alluvial fan of the Chengtu Plain and the plateau of Yunnan. Rather large areas of level or rolling country are located also in Tibet and Mongolia, being mostly in the nature of high plateaus, and there are some level areas in Sinkiang. The remainder of the country is mountainous, much of it being quite rugged. The Chingling Mountains and associated ranges in central China form the natural boundary between the humid rice area of the south and the drier area of the north. Buck (1937) classifies the area south of these mountains as the rice region and that north of them as the wheat region, these being the most important food crops grown in the two areas. Some wheat is grown in the northeastern portion of the rice region. Kaoliang and millet also are important grain crops in some parts of the wheat regions. Some areas in northern China and especially in the more recently developed areas of Manchuria have considerably larger farms and fields than are indicated by the averages given below for the rice and wheat regions. The grasslands lie to the north, northwest, and west of these major crop areas. The three regions are outlined on the map on page 269.

China's farming area is for the most part a land of small fields. Where the country is level they are usually square or rectangular. In the hill country of the south the ricefields are terraced and follow the contours, and the landscape is very irregular. Terracing is used extensively also in the northern portion of the country, but since flooding of the land is not practiced here, as it must be in the rice area, the terraces are not so level and are not built so carefully along natural contours. Irrigation is practiced extensively in many river valleys. Open, unfenced fields are the rule. Individual farms are small. Buck (1937) surveyed a large number of farms in the rice and wheat regions and found the average acreages to be 3.09 and 5.53, respectively. Even these small areas are so broken up that the average number of parcels of land for each farm is 5.6, the rice and wheat areas being nearly identical in this respect. Everywhere in the farming regions there is an oversupply of people and an undersupply of tillable land. Every available plot is pressed into use for the production of human food. This is aptly illustrated by Buck (1937) in a comparison of the use of land in the farming area of China with that in the United States:

Use of land	China	United States
	Per cent	*Per cent*
Crops	89.6	41.9
Pasture	1.1	47.0
Woodland (not used for pasture)	1.7	6.6
Other land	7.6	4.5

RICEFIELDS NEAR CHUNGKING, SZECHWAN
RICE PLANTS HAVE JUST BEEN TRANSPLANTED, BROAD-BEANS GROW ON THE NARROW BANKS BETWEEN FIELDS.

Obviously there is little room for livestock other than the essential working animals in the densely populated areas of China.

The grasslands are made up for the most part of mountainous and high plateau regions. The nomadic and seminomadic peoples in these regions herd most of their livestock on the higher mountainsides and plateaus during summer and bring them into the lower valleys in the winter months. In most of these regions the winter climate is severe. Except for the very high portions of Tibet, Sikong, Chinghai, and Sinkiang, the climate in these provinces is somewhat less severe than in Mongolia and Manchuria, and it is more moist in Tibet, Sikong, and Chinghai than in the other grassland provinces. In all these areas, however, the natural feed supply is low during winter and little feed is grown and stored for livestock. Consequently, animals are usually in poor condition at the end of the winter season, and heavy death losses are frequently incurred. Much of Sinkiang is at a lower altitude than the Tibetan and Mongolian plateaus, and the temperature is generally more favorable to successful livestock production. In all the grassland areas overgrazing and other mismanagement of the grazing areas present problems that are in urgent need of attention. Lack of communication and transportation between these grassland areas and the farming areas is among the factors that have prevented development of a balanced economy such as is found between the western grazing areas and the eastern portion of the United States.

Racially the Chinese are a heterogeneous people. Latourette (1934) states that there is much uncertainty as to the origin of many of the groups. Many invasions of the fertile lands of North China by non-Chinese stocks from the northeast, north, and west undoubtedly left their marks on the population of

A YURT OF THE TYPE USED BY MONGOLIANS

THIS ONE, IN EASTERN CHINGHAI, BELONGED TO KAZAKH TRIBESPEOPLE WHO HAD MIGRATED FROM SINKIANG.

IMPROVED PITS USED FOR STORING NIGHT SOIL AND LIVESTOCK MANURE
AS IT LIQUEFIES THE MANURE IS DIPPED OUT AND SPREAD OVER THE FIELDS. SOME OF THE RICEFIELDS IN THE BACK OF THE PHOTOGRAPH HAVE BEEN DRAINED AND ARE PRODUCING A GOOD CROP OF WINTER VEGETABLES.

that region. The Koreans have intermingled with other stocks to some extent, especially in Manchuria. Similarly, there are several types in the southern portion of the country, owing to mixing of the Chinese with native tribes and with other peoples of southeastern Asia. In addition to the Chinese the predominant groups are the Tibetans, Mongolians, and Mohammedans. The Mohammedans, of course, are not a distinct racial group but include at least Turkish, Mongolian, and Arab stock, mixed with Chinese. In addition to the major groups there are many tribes that are of lesser importance numerically, such as the Kazakhs of the extreme northwest and the Miao of the mountainous regions of Kweichow and adjacent territory.

The Chinese are the predominant racial stock in the densely populated farming areas. Less aggressive native tribes, such as the Miao, have been pushed back into the poorer mountain regions. Chinese farmers have also moved into the more fertile lands at the border of the Tibetan and Mongolian areas and many have migrated into Manchuria, and in these border regions there is conflict between the pastoral and agrarian economies. Mohammedans are found in largest numbers in Chinghai, Kansu, Ningsia, and Sinkiang Provinces.

The Chinese farmer is a tiller of the soil and has made much progress in the development of terracing, irrigation, and other methods of preserving the producing capacity of the soil. But he is not so skilled in animal husbandry. Apart from animals used for draft power, livestock plays a minor part in his farming operations. Owing to small farms and relatively low productivity resulting from lack of adequate replacement of soil nutrients, most of his available land

must be used for the production of human food, leaving little space or feed for livestock.

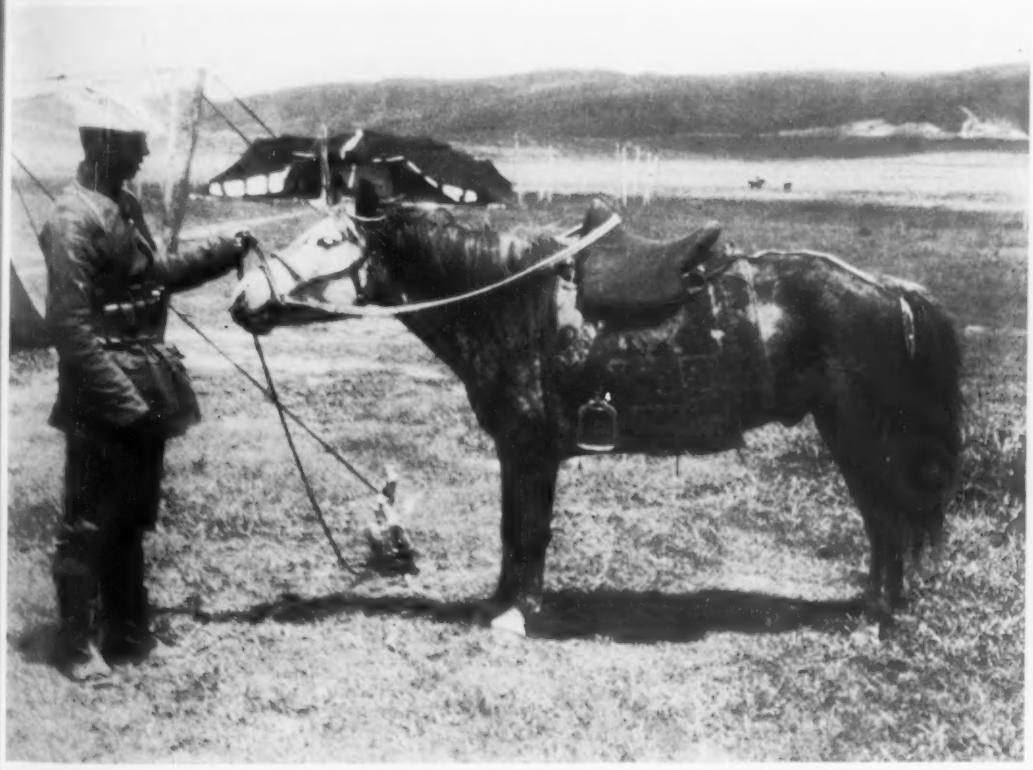
The nomadic and seminomadic groups of the Inner-Asian grassland areas are largely dependent upon livestock for their existence and therefore have a greater natural interest in animal husbandry, but little effort has been expended by them in livestock improvement. Most of these people live in areas where the winter climate is severe. There is relatively little land upon which crops can be grown successfully, and almost no attempts have been made to utilize any of this land for the production of supplemental feed for the livestock.

The uses of various types of livestock are described briefly below. Detailed descriptions of the types of livestock are given by Phillips (1944) and Phillips, Johnson, and Moyer (1945).

Horses, Donkeys, and Mules

Horses were used most extensively in the past by nomadic and seminomadic people in the grassland areas, while donkeys were used primarily by Chinese farmers. Neither horses nor donkeys are of much importance in the rice area, except along highways and in some very mountainous regions. Horses have penetrated the dry-farming region and are now used extensively there for farm power, along with draft cattle. Donkeys are used very little in the grasslands, except along the borders where Chinese farmers have moved into the valleys that can be cultivated, but they are used for all types of work in other areas. Mules are produced wherever donkeys and horses co-exist, but the important production centers are in the Wei and lower Yellow River Valleys, in area B of the map on page 269.

In addition to their use on farms, horses, donkeys, and mules are utilized extensively in commercial transportation, both as pack animals and for pulling carts. Roads that can be used by motor vehicles are as yet only



MOHAMMEDAN CAVALRYMAN OF CHINGHAI'S PROVINCIAL ARMY DISPLAYS HIS MOUNT

A DONKEY–AND–BULLOCK TEAM
PHOTOGRAPHED ON A FARM IN SHANSI BY DR. R. T. MOYER, OFFICE OF FOREIGN AGRICULTURAL RELATIONS.

ribbons at infrequent intervals through the farming areas and grasslands of most of China. Much of the produce and goods moved between the rural areas and key points on these roads must be carried by pack caravan or on the backs of men. Horses, donkeys, and mules, along with cattle, yak, *pien niu* (yak-cattle hybrids), and camels, play an important part in the commerce along the narrow trails that wind among rice-fields, over hills and mountains, and across deserts to China's villages and other rural trading centers.

Horses and their relatives are used extensively for riding in the grassland areas but only to a limited extent in farming regions. Chinese saddles are not built for comfort, even though they are frequently decorated in attractive and picturesque designs. For long rides heavy quilts are usually placed over the saddle as antiblister insurance. In the dry-farming area and adjacent regions it is a common custom for riders of donkeys to sit over the hips of the animals; as a result they feel only the movements of the rear legs.

Chinese horses are of three major types: the Mongolian horses of the grassland and dry-farming areas, the ponies of the rice region of southeastern China, and the small horses of Sikong and portions of adjoining provinces. There is considerable variation within each type, and several subtypes may be recognized among the Mongolian horses.

There is much variation in size among the donkeys. Small and medium-sized animals predominate, except in the Wei and lower Yellow River Valley areas, where many large donkeys are found. Jacks of this larger type are especially prized for use as sires of mules.

Most of the mules are produced by mating donkeys to Mongolian mares, and the size of the mule depends to a large extent on the size of jack used. The mules sired by large jacks are highly prized for pulling the heavy carts used in highway transportation.

Good horsemanship is little known in China, except among some of the grassland peoples. Animals in cart and pack caravans are usually driven by whip and voice. Those in carts are frequently reined tightly, to the point of cruelty. Those that are used for riding are often not well broken or trained. Many of them are accustomed to going their own gait, regardless of the will of the rider. Overloading of animals used for packing and in highway transportation is the rule.

Camels

The "ships of the desert" are important in most of the grassland area (C on map), except Tibet, Sikong, and eastern and southern Chinghai. They travel also outside this area, in commercial transportation, especially in Kansu, northern Shensi and Shansi, Hopeh, and Jehol Provinces. They are used primarily as pack animals and to some extent for riding. Camel's wool is collected at the

A MONGOLIAN PRINCE AND HIS HORSE
PRINCE TA LI TZA YA, OF ALASAN BANNER, NINGSIA, PROUDLY DISPLAYS ONE OF HIS BEST MOUNTS.

HORSES AND MULES PULL MUCH OF THE FREIGHT ALONG FREE CHINA'S HIGHWAYS
CARTS AND THEIR "HORSEPOWER" LINED UP IN FRONT OF STAGE TRANSPORTATION DEPOT IN LANCHOW, KANSU.

time of shedding in spring and is an important by-product from these work animals. Some camel milk also is used.

Camels are worked mostly during the cooler months of the year, partly owing to the necessity of keeping them out of the summer heat and also owing to the need of fattening them during spring and summer so that they will be able to work during the following fall and winter. Feed supplies are scarce along the caravan trails, and as a result the reserve energy stored in the animals' humps is used up; by spring the humps are thin and fall over to the sides of the animal. The camels are then taken to the mountains to graze, and the humps gradually fatten and become erect.

Most of the camels in China are of the Bactrian, or two-humped, type. There are reports indicating that some of the one-humped type, or dromedary, may be found in Sinkiang and possibly in Manchuria.

Cattle, Water Buffalo, and Yak

Cattle are used throughout China. Water buffalo are limited almost entirely to the rice area (A on map), where they are the most important work animals in the ricefields. Yak are found in large numbers in the Tibetan areas and in Mongolia.

Cattle are the chief source of power on farms in the dry-farming region but share this responsibility with water buffalo in the rice region, where water buffalo are more numerous in some provinces and cattle in others. In addition to their use in all kinds of farm work, cattle are employed extensively as pack animals, especially in southern China, where relatively few horses and donkeys are available. In the grasslands and adjacent areas in the dry-land farming region cattle are used also for milk production.

All cattle in China are called "yellow cattle" to distinguish them from water buffalo and yak. There are three main types. The draft cattle of the farming regions (A and B on map) are muscular and have a hump. The cows are not milked except by their calves. The cattle in most of the grasslands are less muscular, have no hump, and the cows give only a small amount of milk. They are commonly called Mongolian cattle and are found in all the grassland provinces, except Tibet and Sikong, and also in the northern portion of the dry-farming area (B on map). There is considerable variation in size and form within these major types. A third type is composed of the very small, lean cattle of Tibet and Sikong. It is not certain whether these small cattle are related to Mongolian

cattle or are of the same stock as the small hill cattle of northern India.

Water buffalo, like cattle, are used chiefly for work. They are adapted to work in the water and mud of the ricefields and are used almost entirely for this purpose. Some are used in sugar mills, salt wells, and other commercial enterprises. In some areas they have been utilized for producing milk, but this has been rather limited and their production is low.

Farms are usually small and have only one or two draft cattle or water buffalo. Since the farming operations depend upon these animals, they are given as good care as the feed supply and other environmental conditions will permit. Animals that are used in pack caravans and other commercial work are treated much less kindly, even brutally at times. Overloading is the rule.

The yak is the most important animal in the Tibetan area and is important also in Mongolia. It is used mainly as a pack animal and for milk production and to a limited extent as a draft animal and for riding. Its long hair is utilized for making cloth for tents and for certain other purposes. The lives of many Tibetans are dependent upon the yak. These animals are herded on the high mountains in spring, summer, and fall and in the valleys in winter. During spring and summer, butter and a crude casein are manufactured and stored for use during the winter months. Animals are sometimes kept alive during severe winter storms by feeding them the dried casein. Butter is mixed with tea to make the Tibetan's favorite drink, buttered tea. And they like it rancid. Fresh butter is *not* preferred. It is used also as a cream to protect their bodies from wind and as fuel in the candle pots in the lamaseries. The odors are terriffic. In the words of one missionary, when describing the meetings of Tibetans in his little chapel during the winter months, with a stove keeping the room warm, he felt that at these times he was "really serving the Lord."

The *pien niu*, a hybrid between yak and cattle, is usually produced by mating a yellow-cattle bull to a yak cow. The hybrids are larger and stronger than yak. They are prized as pack animals, and females are generally believed to produce more milk than the yak cows. They are produced in all areas where yak are found. All available information indicates that the male hybrids are sterile, but the females are fertile. Their offspring are considered to be less productive than *pien niu* or yak, regardless of whether they are mated to a yak or yellow-cattle bull, although no direct evidence is available on this point. Uncontrolled breeding in areas where yak are raised naturally makes the utilization of the *pien niu* females in breeding operations difficult.

Old and injured cattle, water buffalo, yak, and *pien niu* and occasional surplus animals are slaughtered for food. Among the Chinese there is a rather widespread feeling that animals that have worked faithfully

CATTLE ARE USED EXTENSIVELY AS DRAFT ANIMALS

Left: COWS PULLING A WOODEN PLOW IN A HIGH VALLEY NEAR TOP OF THE CHINGLING MOUNTAINS, SHENSI. *Right:* WATER BUFFALO ARE USED MAINLY IN RICE AREAS; THIS ONE PULLS A HARROW IN A SZECHWAN FIELD.

LIVESTOCK SERVES MANY NEEDS OF THE CHINESE FARMER

Left: TIBETAN WOMAN MILKING A YAK. THE SILVER BOWLS ON HER BACK ARE PART OF THE FAMILY FORTUNE. *Right:* A BULLOCK, BLINDFOLDED TO PREVENT DIZZINESS, TURNING A SMALL MILL OF TYPE COMMONLY FOUND.

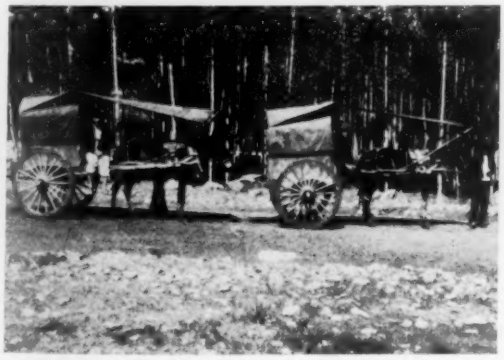
should not be slaughtered and eaten. The Tibetans not only slaughter animals but also frequently eat those that die accidentally or of any disease other than anthrax.

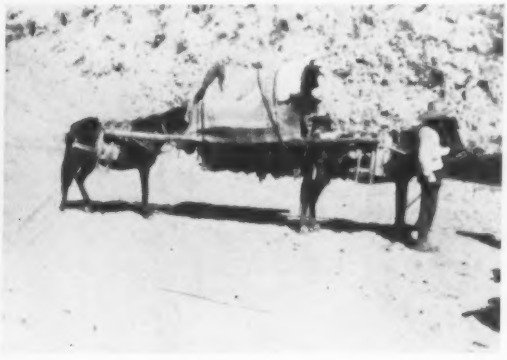
Sheep

Sheep are of great importance to the peoples of the grasslands, of less importance in the dry-farming region, and of relatively little consequence in the rice region.

Mutton is the most important meat in the grassland areas. Wool is made into clothing, blankets, rugs, and felt. The felt is used for boots and to cover the yurts in which many Mongolians and some others live. Pelts of the young sheep are used to line gowns as protection from the cold winds. Some skins are made into leather. Inflated sheepskin rafts are used on the Yellow River. Droppings collected in corrals at night are utilized as fertilizer or for fuel. Some sheep are milked to obtain human food. Surplus wool is sold to provide some cash for purchase of the few manufactured articles used in the simple life of the grassland peoples. Hence, throughout the grasslands, sheep are the most important animals in the basic economy of the people.

Sheep in the grasslands are usually herded in flocks of 100 or more, with some flocks numbering 1,000 or more. The largest flocks belong to lamaseries and government officials. In the farming areas flocks are usually less than 100 and often include only a few sheep. They are grazed during the day, under the care of children or old men or women, and are brought into the village or farmhouse at night. In many villages the sheep of all families are grazed as one flock, with each family taking its turn at the herding or paying a herder's fee in proportion to the number of animals owned. In the dry area of the northern portion of the farming region sheep are quite important in the economy of the





TWO KINDS OF CHINESE CONVEYANCES

Left: PEKING CARTS, SUCH AS ARE IN COMMON USE IN THE DRY-FARMING AREAS OF NORTH CHINA. *Right:* A MULE-SEDAN CHAIR. DONKEYS AND MULES ARE USED EXTENSIVELY, ESPECIALLY IN THE DRY-FARMING REGIONS.

people. In the rice area there is little land for grazing, and the warm, damp climate intensifies the parasite problem, and so sheep are important only in the more mountainous provinces and in a few silk-producing areas where they are confined and fed on mulberry leaves, the manure being used to fertilize the mulberry trees.

There are three major types of sheep in China: Mongolian, Tibetan, and Kazakh. Mongolian sheep are a fat-tailed type, some having tails that weigh as much as 20 pounds. Several subtypes may be recognized within the Mongolian type. The Tibetan sheep have a short and very small tail. Kazakh sheep, so called because they apparently were brought into northwestern China from Kazakhstan, are a fat-rumped type. All types have a fleece with a long, coarse outer coat and a shorter fine under coat. The wool is reasonably good for carpets, and China is known in the world wool trade as an important source of carpet wool. In China the outer and under coats are frequently sorted by hand so that the under coat may be used in making finer-quality materials. In some Mongolian and adjacent areas it is common practice to comb the under coat from the sheep in spring, and to shear the outer coat sometime during summer or fall.

PRODUCTS OF CHINA'S SHEEP HERDS

Left: MOHAMMEDAN SOLDIERS OF CHINGHAI'S PROVINCIAL ARMY SPINNING YARN FROM WOOL. *Right:* SOLDIERS WEAVING LONG STRIPS OF CLOTH THAT WILL BE CUT INTO LENGTHS AND SEWN TOGETHER TO MAKE BLANKETS.

Goats

Goats are found in all parts of China. They graze with the sheep in the grasslands and in the dry-farming region and are also rather numerous throughout the rice region where few sheep are raised. In the rice region they may be herded in small bands or tethered individually for grazing. Goats are raised primarily for their meat and skins. Definite figures are not available, but goat meat probably ranks next to pork in amount eaten in the Chinese farming areas and next to mutton in the grasslands. Goatskins were an important item in China's export trade before the present war. In some areas the native goats are milked, but production is low. Fiber is sheared from the long-haired types. It is utilized for weaving coarse cloth such as is used in grain bags.

There is much variation in size, color, body form, and type of coat among the goats of China. Those in many areas have not been described, and the types in areas where they have been described are too varied to be characterized here.

Swine

Swine are important in all areas where Chinese predominate. Pork is a favored article in their diet. In the grassland areas there is little feed suitable for swine; consequently few are raised. In northwestern China, Mohammedans make up an important part of the population, and their religion prohibits the eating of pork.

The growing pig is used largely as a scavenger and to turn vegetable refuse and other rather coarse feeds into manure for the fields.

Sows are usually kept by wealthier farmers. Many pigs when about six weeks old are sold to poorer farmers, who feed them on rough feeds for a time and resell them to other farmers to get a little cash. This process may be repeated three or four times, in some areas, before the pigs are finally purchased by wealthier farmers or owners of sugar factories or distilleries for fattening on concentrates for a relatively short period. A hog may be eighteen months to two years old before it is slaughtered.

Fat hogs go to market in several ways. Many are driven on foot over distances up to five miles, sometimes farther. In order to avoid loss of weight a hog for market is often tied to a board and carried on a coolie's back, or suspended on two bamboo poles and carried by two men after the fashion of a sedan chair. In some areas they are tied feet up on wheelbarrows and pushed to market.

Owing to lack of refrigeration pork must be sold within a short time after the animals are slaughtered. The common practice is to begin slaughtering about midnight, so that the meat will be in the retail markets early the following morning. A Chinese city is never quiet. Even in the dead of night when no light is visible one can hear a variety of sounds, and among these is the squealing of pigs.

Bristles are an important by product of the Chinese hog, especially in normal times. The longer bristles from the back are pulled, clipped, or scraped off and then cleaned and processed for sale, ultimately to be used in the making of brushes. The soft bristles are carefully combed out, and the stiff ones are sorted and graded according to lengths and tied in small bundles for marketing. The sorting and grading requires much skill and nimble fingers.

Chinese hogs are of two major types. Those of northern China (approximately the same region as area B on map) are black and have long, straight faces, large ears, and rela-

GOATS, AS WELL AS SHEEP, ARE FOUND IN ALL PARTS OF CHINA

HERE A MOHAMMEDAN SOLDIER WATCHES A PORTION OF A FLOCK OF GOATS ON THE GRASSLANDS OF CHINGHAI.

SCENE IN WEANLING-PIG SECTION OF LIVESTOCK MART AT YUNGCHANG, SZECHWAN
PIGS COME TO MARKET IN BASKETS. THE TWO CENTER MEN, SEEMINGLY SHAKING HANDS, ARE BARGAINING. BIDS ARE MADE BY FINGER SIGNALS IN THE SLEEVES, SO THAT ONLOOKERS CANNOT KNOW PRICE AGREED ON.

tively long, thin bodies. Those of southern China (area A on map) are shorter and more rotund. Their faces tend to be dished and the ears are smaller. Some are black; others are black and white. In some sections a few red or brown animals are found intermingled with blacks.

Poultry

China is commonly thought of as a country with many chickens, owing to her importance as a source of dried eggs. But most farms have only a few birds, usually less than ten. Commercial poultry farms of the type and scale common in the United States are practically unknown. Chickens are kept on most farms and around homes in villages, primarily as scavengers of kitchen and farm wastes. Egg production is low, approximately 50 eggs annually per hen. The surplus eggs are sold, as a source of cash income, in the local markets. Before the war most of the dried eggs were produced in foreign-owned factories along the railroads, where it was easy to collect large quantities from the local markets.

Ducks are kept on farms in small numbers as scavengers. Specialized operators also herd large numbers of them in the ricefields. At the time the rice is harvested these operators, usually two or three men, carrying a small bamboo house and cooking equipment with them, assemble several hundred to a thousand young ducks. The flock is driven slowly to a central marketing point, feeding on fallen rice in the fields along the way. In exchange for the rice picked up in their fields the farmers get the manure that is left behind.

Geese are kept in small numbers, usually no more than one pair to a farm. They are prized as house watchers, owing to the noise they make when any strange animal or person approaches.

Chickens and ducks and their eggs provide important sources of animal protein in the Chinese diet. Birds, as well as eggs, are sold in the marketing centers on regular market days. They are commonly carried in large, specially constructed bamboo baskets, one basket being suspended on each end of a shoulder bar.

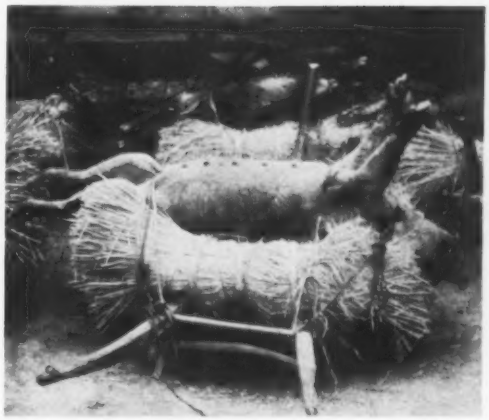
The Chinese have developed an interesting and effective method of incubating eggs, particularly duck eggs. They place the eggs in net bags and pack them in barrels or boxes of hot rice, which is changed at frequent

intervals to maintain a reasonably constant temperature. A high degree of skill and watchfulness is necessary to obtain success with such a method. Another method is to incubate the eggs on heated kangs, or earthen beds. No thermometers are used, the operators depending entirely on their sense of touch to maintain proper temperatures.

Improving Chinese Livestock

Many agricultural workers in China, as well as those of other countries who have dealt with China's agricultural problems, feel that China is and must continue to be a crop-producing country, owing to the extreme pressure of population. This viewpoint is reasonably accurate, if one thinks only of the densely populated farming regions, but there are possibilities of improving the contribution of livestock to the well-being of the people. For example, there might be developed milking strains of water buffalo and cattle, to serve for the production of both work and milk, and milking strains of goats that would produce milk in addition to the present important products of goats, namely, meat and skins. For the country as a whole livestock is important and should make a much larger contribution to China's economy than it does at present.

From the standpoint of types of agricultural production and distribution of population, China is similar to the United States. The densely populated and the intensively cultivated areas are in the southeastern and east-central portions, while much of the west and northwest is suitable only for grazing. The basic difference is that in China the pastoral and agrarian economies are not brought together by adequate transportation and political ties. With improved transportation political ties could be strengthened more easily, of course. Those familiar with the broad agricultural picture in the United States know that much of our beef, lamb, and wool is produced on western ranges. Many feeder cattle and lambs move into midwestern crop areas for fattening and then on to the eastern population centers for consumption. With adequate transportation this picture could be partially duplicated in China. Surplus grain would not be available for extensive fattening operations, such as are carried out in the Corn Belt of the United States, but grass-grown cattle, yak, sheep, goats, and horses and some of their products, such as wool, hides, bones, and butter, could move into the densely populated areas for consumption, manufacture, or work. Then densely populated areas would in turn have a new market for manufactured goods and surplus food.



A SZECHWAN PIG GOES TO MARKET

Many Chinese think of grasslands as wastelands. One frequently hears of plans sponsored by high political officials, which

MEAT IS SOLD IN OPEN-AIR MARKETS

MUTTON IS THE ONLY MEAT OFFERED FOR SALE AT THIS MARKET IN TAER-SZ, CHINGHAI. THE FAT IS CUT AWAY IN STRIPS TO DISPLAY THE LEAN PART.

appear logical to untrained observers and workers, to expand greatly the human and livestock population of the grassland areas, so that these so-called "wastelands" can be more fully utilized. Such programs cannot hope to succeed except in a few very limited localities. In many areas the numbers of livestock should be reduced, and in only a few areas could any increases be made successfully at present. With the development of adequate methods of range management and control of grazing, the total livestock

GAZELLE SKIN ON DISPLAY
THE OFFICIAL IS MA LU, THE MOHAMMEDAN COMMISSIONER OF FINANCE IN THE PROVINCE OF CHINGHAI.

population could be gradually increased, and with this some increase of human population could be made. But such developments should be preceded by adequate development of the range and by development of the small amounts of available adjacent lands that are suitable for cultivation, so that they would supplement the range industry rather than conflict with it, as they do now.

The view that livestock numbers are at or near the maximum for existing range conditions is supported by all trained observers who have visited the grasslands and with whom the writer has discussed this problem. It is also the conclusion of Ross (1936), who studied the problem in Manchuria and in parts of Inner Mongolia. In western Manchuria and Inner Mongolia severe droughts are not uncommon, and these when they occur may accentuate the effects of any tendency toward overstocking. Cressey's summary (1934) of the potentialities of the Central Asiatic steppes should be cited in connection with this problem: "In this waste all life struggles incessantly against the restrictions imposed by the climate and only those plants and animals survive that can adjust themselves to the meager resources available. The possibilities of occupation, shelter, food, fuel, and clothing are all laid down by nature. The one resource is an uncertain supply of short dry grass."

There is a basic conflict between the nomads and the farmers that encroach on the edge of the nomad lands. These farmers move in and develop small subsistence farms in the valleys where the nomads have been accustomed to grazing their animals during winter and early-spring months. The nomad is thus pushed out of grazing land that he needs for the most critical seasons of the year. Much of this land is marginal, and the result is that the farmer makes a poor living and the nomad has a poorer living than he had before. As this process goes on the nomads suffer more, and the country as a whole loses products that it needs badly. The logical development in such areas is to devise a system of agriculture in which the available cropland is used to grow supplemental feed for the range livestock so that they can be carried safely through severe winter storms and early spring when feed is very scarce on the range itself, plus some food for the livestock owners themselves. This would eliminate much of the winter death loss, and the females would be better able to maintain pregnancy and nurse their young satisfactorily in spring and summer. The result of such a development would be greatly increased supplies of wool, meat, and

leather and other products for use in China and an improved market for manufactured products from other parts of the country.

The basic conflict between the nomad and the farmer was recognized in Manchuria and Inner Mongolia by Ross (1936), who stated: "So far as the present volume of wool production in Manchukuo and Inner Mongolia is concerned, by far the greater part of this comes from the purely pastoral zones and very little from the agricultural areas. In the border territories between these two zones, there is likely to be increasing competition between the demands of an agricultural and pastoral economy, so the tendency will be for sheep grazing to be increasingly restricted rather than the reverse." It appears also that this same conflict between farmer and nomad was partially responsible for the break between Outer Mongolia and China at the time of the fall of the Ching Dynasty, owing to resentment among the Mongols over repeal of laws that had until a short time previously prevented colonization of their grazing land by Chinese farmers. The fall of this last dynasty gave them opportunity to break away from a government that had not recognized their basic needs and rights.

Another misconception in China, at least in some grassland areas, is that a man's wealth is measured by the number of animals he owns. The important point is not how many ainmals he owns but how much usable or marketable product he is able to harvest from those animals each year. In many cases it is possible to increase production by reducing numbers to the optimum carrying capacity of the range.

Immediate improvement in the producing capacity of the grassland areas can be brought about by improving the hereditary capacity of the animals to produce wool and other products, and, as has already been emphasized, increases in numbers should await growth of an adequate feed supply.

In the crop-producing areas of China the major effort is now expended on the production of grain for human food, and with the existing density of population it is necessary that this emphasis continue. But there is room for increased emphasis on livestock and

DONKEY IS "DOCTOR'S" TRADE-MARK

NATIVE MEDICINES ARE CARRIED IN THE SADDLE-BAG POUCHES, PATIENTS ARE SEATED ON THE DONKEY FOR DIAGNOSIS, AND SIGNS ADVISE PEOPLE TO GET WELL QUICK ON A HORSE. IN SZECHWAN.

for improving the environment of livestock without interfering with the production of human food. In grassland areas crop production should supplement livestock production, while in farming areas livestock should supplement crop production. Careful studies should be made of the possibilities of producing more forage crops, especially legumes, and root crops that could be used for livestock feed, so that the diets of working animals on these farms can be improved. Similar studies should be made of the possibilities of improving the methods of feeding swine and poultry. Some grain might be diverted from human consumption for these purposes and to support milk production, either by animals used for work or by goats kept for this purpose, in order to increase the amounts of animal protein and calcium in the diets of farm people. There must be provision for sufficient good-quality forage and other feeds if these animals are to provide a sufficient supply of milk for the farm family. Marketing of some crops through livestock is essential to the maintenance of soil fertility by return of manure to the land.

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INFLATED SHEEPSKIN RAFTS ARE USED ON THE YELLOW RIVER
AS MANY AS 300 SKINS ARE TIED TOGETHER FOR LONG DOWN-RIVER TRIPS, AFTER WHICH THE SKINS ARE SOLD.

The problems of diseases and parasites must also be considered in the improvement of the environment. Chinese workers are now conscious of the disease problem but are apt to overemphasize the relative importance of the serum bottle and the injection needle. Production of viruses and serums is vital to the maintenance of livestock health, and there is no intention here to minimize its importance. However, there is need for greater emphasis on sanitation, on management practices that help to control parasites, and on improved nutrition, so that the animals will have sufficient reserve energy to better withstand disease and parasitic attacks.

Most of the farm livestock and poultry in China are of rather primitive unimproved types. Some of the existing types are meeting the needs of the country reasonably well in certain of their functions. These need to be improved in certain other functions so that they can make greater contributions to national welfare. Other types are in need of improvement in all their productive characteristics. There are three main methods by which improvement in productive capacity could be brought about: (1) Selection within the native types, (2) grading up with already improved types of breeds from other countries, and (3) development of new types out of animals that are graded only part of the way up to the purebred type.

Selection within native types has certain advantages. There is then no problem of selection and importation of foreign stock, and the native types are already adapted to the local environment, which may not be true of types brought in from other countries. The disadvantage of this method is that progress will be much slower than with grading up with already improved types, provided the improved types meet China's needs and are adapted to the environment.

Grading up has the obvious advantage of making possible rapid improvement, through the breeding of improved males with large numbers of native females. This is the logical choice in all cases where there are existing types in other countries that meet China's needs and that are apt to be able to perform satisfactorily under Chinese conditions. If this method proves satisfactory, foreign or other improved herds need be maintained only as sources of males to continue the grading-up program, while the bulk of the animals in the country would become high grades as the program progressed.

In many cases it may be found that the foreign purebred animals are not able to perform well under existing environmental conditions. Grades that are carrying a certain amount of improved breeding may give satisfactory performance and produce at higher levels than the native stock. In such cases the obvious procedure is to determine the extent to which improved breeding can be introduced and then to develop a new type from animals with this breeding background.

Inbreeding is a useful tool in livestock improvement, once improved types are reasonably well established, but it seems probable that it should be avoided so far as possible in the early stages of an improvement program in China. Inbreeding in the improved stocks that are used for grading up or developing new types would not be objectionable, particularly if it had been used as a means of increasing the homozygosity in outstanding strains. But its use in developing improved types by grading up and then selecting to fix a new intermediate type should be avoided until the new type has been fixed to some extent by selection. To do this a large number of sires should be used in initial stages of such programs.

Hybridization will continue to be useful as a means of producing mules, and also *pien niu*, provided satisfactory methods can be developed for utilizing the *pien niu* females effectively in continued breeding operations.

Livestock improvement in China will depend not only upon bettering the environment and adopting sound genetic approaches to the breeding problems but also upon a realization by political and scientific leaders of the part that livestock must play in the development of a well-rounded agriculture and a well-balanced national economy.

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NEPTUNE'S RACETRACKS

By C. WYTHE COOKE

SOME folks attribute them to a comet, a flock of "shooting stars," a cluster of meteorites. But what really shaped the racetracks in the Carolina bays was the galloping hooves of the white-maned horses of Neptune.

One would scarcely notice their curvature from the ground. They appear to be merely low, broad ridges of loose sand that rise only a few feet above the swamp and stretch in front and behind as far as one can see between the tall pines that cover them. Hunters follow them because they provide a firmer footing than the mucky swamp on either side. Along them straggle logging roads that come from nowhere in particular, pathways where woodsmen haul great trunks of pine and cypress.

It is only from high in the air that the shape and size of the ridges become apparent. Their light sandy soil contrasts strikingly with the black humus of the adjoining bays, from which they stand out conspicuously as slender oval rings a mile or more in diameter, white racetracks on a black field. Their shapes are remarkable, for some form nearly geometrically perfect ellipses, and all approach the elliptical outline. Their orientation is even more surprising, for all are elongated in the same direction, which the compass shows to be exactly northwest-southeast, exactly bisecting the cardinal directions (Figs. 1–3).

The elliptical shape, the parallel trend, and the further fact that many of the rings are broadest near their southeastern ends led two young geologists to suggest, in 1933, that these unusual markings might be scars made by the impact of a swarm of meteorites, possibly the nucleus of a comet, that were traveling through space in the same direction and struck the earth a glancing blow, gouging out an oval hollow and heaping most of the flying debris at the farther end of the excavation.

To the casual reader this explanation has much to commend it and appears to be quite plausible, but on closer analysis the hypothesis is found to be utterly untenable. No fragments of meteorites have been found near the supposed scars. The sand rings are much too low and narrow to contain the material splashed out by a projectile large enough to have made such a big mark. Even if the sand piles had later been worn down by the sea, as some proponents claim without a shred of evidence, the rings would still be too small, for they should have become wider as their tops were removed by erosion. Moreover, the scar in Arizona called Meteor

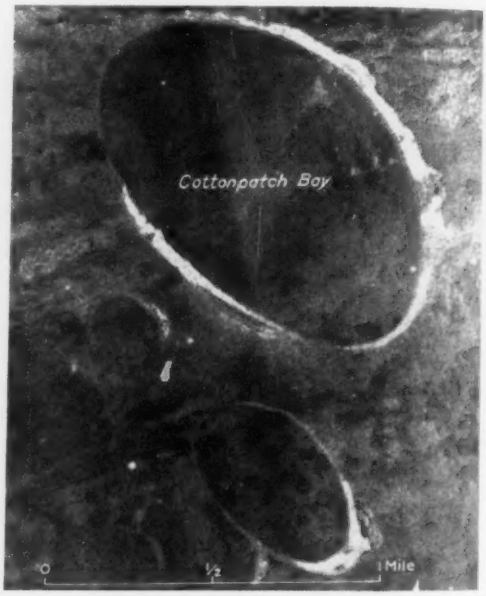

FIG. 1. "NEPTUNE'S RACETRACKS"
SAND RINGS WITHIN AN OLD LAKE BASIN 7 MILES NW. OF MYRTLE BEACH, N. C. WAVES BREAKING AGAINST THE EASTERN SIDE OF COTTONPATCH BAY STARTED AN EDDY, WHICH BUILT THE SAND BAR SURROUNDING IT.

Crater, which is known to have been made by a meteorite, is not elliptical but nearly circular. Genuine meteorite scars are nearly circular because the intense heat generated by the terrific impact instantly explodes the near-by ground water into steam, which blows out a circular hole.

Much more evidence that the sand rings are not meteorite scars might easily be marshaled, but it seems needless to expand the

argument here. The late Prof. Douglas Johnson, of Columbia University, a world-famous geographer, once president of the Geological Society of America, devoted 100 pages of his book on *The Origin of the Carolina Bays* to an impartial analysis of the evidence for and against the hypothesis. He stated emphatically that the sand rings are not meteorite scars. All but a few geologists who had weighed the evidence, pro and con, were of the same opinion even before Johnson's book was published in 1942. Nevertheless, the hypothesis has such appeal to the popular imagination that it still offers a fertile field to writers of fiction. So, it is not surprising to find in the *Saturday Evening Post* for September 9, 1944, an article by Herbert Ravenel Sass on *When the Comet Struck*, in which that talented writer gives free flight to his fancy. No doubt Mr. Sass found particular pleasure in writing that imaginative article, in which he describes what might have happened if a shower of meteorites had struck his beloved "low country" of South Carolina.

It was on airplane photographs taken in the heart of the "low country," near Conway, S. C., that the so-called meteorite scars were first detected. Similar features had been noticed long before near Darlington, S. C., but the preposterous meteorite hypothesis was not suggested until photographs of the peninsula that separates the Waccamaw River from the Atlantic Ocean showed them in great abundance seven miles north of Myrtle Beach and extending eastward to the North Carolina state line. Subsequent search has revealed them in the neighboring counties of North Carolina and as far west in South Carolina as Allendale and Hampton Counties.

To the trained eye of the geomorphologist, or student of land forms, it is at once apparent that the flat, swampy bogs within the sand rings are ancient lake basins that have become choked by the long-continued growth and partial decay of water-loving plants. Some of the basins still retain patches of open water too deep for sedges to take root. It is evident also that the sand rings themselves are merely beach ridges and bars shaped by waves and currents before the

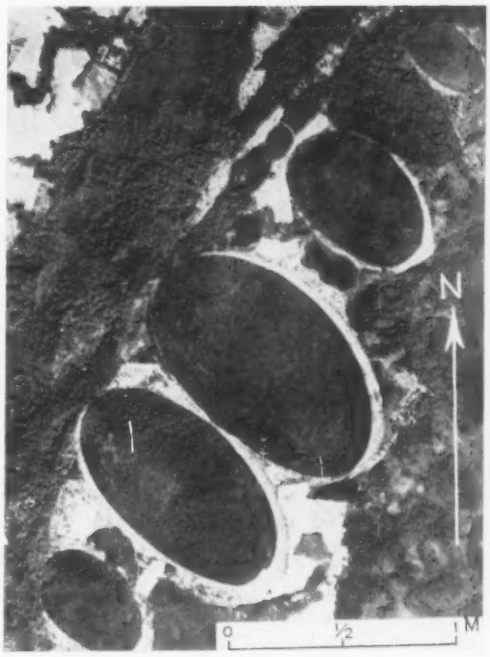

FIG. 2. SAND RINGS IN MARION COUNTY, S. C. NW. OF GALIVANTS FERRY. ALL APPARENTLY SHAPED BY EDDIES IN ONE BODY OF WATER, THE 2 LARGE ONES BY COMPLEMENTARY EDDIES, ONE (THE NORTHEASTERN) FLOWING CLOCKWISE, THE OTHER COUNTER.

shallow water near shore was overgrown by vegetation, which prevented further modification and protected them from the attack of storm waves. Nearly every existing sand-bottomed lake is ringed by a similar more or less well-defined beach ridge that rises a few feet above the water level. Some modern beach ridges expand into dunes, or areas of wind-blown sand, just as many of the sand rings in the Carolina bays are widest along one of their sides.

Even adherents of the meteorite hypothesis admit that the sand rings once enclosed lakes. What is more natural than that a meteorite scar should fill with water? But if the lake basins are not meteorite scars, they say, how do you account for their perfectly elliptical shape and their parallel trend? To answer this we must call on the horses of Neptune, whipped by Zephyrus, the West Wind, and guided by Gyraea, the goddess of the whirlpool and the spinning top.

Mortal eyes cannot see this goddess, except sometimes dimly in the heart of the hur-

ricane or in the vortex of the twisting tornado or waterspout. But she sits by the side of the pilot of the airliner and keeps his compass pointed at the North Star. She lurks within the *Queen Mary* and steadies her against the storm. Invisible, she holds erect the boy's spinning top until its speed begins to slacken, then, as it starts to topple, whirls its axle, ever faster, round and round.

This invisible force, the "goddess Gyraea," resides in every particle of matter, solid, liquid, or gaseous, that moves in a curved path. It imparts to the whirling flywheel two peculiar properties, gyroscopic properties, that it does not have when not revolving. First, Gyraea strongly resists every effort to change the direction of the axle of a whirling flywheel, but she permits the flywheel to be moved freely in any direction so long as the direction of its axle remains fixed in space. This is the property that holds a rapidly spinning top upright and permits it to be moved around while still spinning. It is the property that gives stability to the gyrostabilizer used in ships. It is the fundamental property of the gyroscope.

A second property is this: When pressure is applied to a point on the face of a whirling flywheel the wheel tilts sideways instead of yielding directly to the pressure, and this sidewise tilting has the same speed that the direct tilting would have if the wheel were not spinning. If the sidewise tilting (physicists call it precession) is resisted, the wheel twists around until its axle lies at right angles to the pressure, parallel to the line about which it is forced to revolve.

This second gyroscopic property is illustrated by the leaning top; the weight of the top tends to pull it over, and so it circles sideways instead of falling flat.

But, you wonder, what has Gyraea, the goddess of whirling motion, to do with placid ponds, limpid lakes, and the shape of the beach ridges that surround them? Why is she not out rolling hoops and spinning tops with the kiddies? And what are the horses of Neptune doing so far from the sea? And why call on Zephyrus, reputedly the gentlest of all the winds, to lash the horses into action?

Now, placid lakes do not remain placid when the wind blows across them. Even a gentle breeze is sufficient to ripple their surfaces, and a brisk gale soon starts the waves to prancing. With white manes flying they roll evenly across the water, rise in the shallows, and dash up the beach in a burst of foam. Where they strike the shore obliquely they carom back, and the broken wave is carried forward along the beach. Before long a continuous current is set in motion along the exposed shore, and a return current either hugs the opposite bank in the lee of the land or strikes back across the open lake. Under either condition the water is rotating as in an eddy—forward on one side, back on the other—and playful Gyraea leaves her toys and takes the reins. Let us see what course she will follow.

An eddy may be compared to a great flywheel. Each drop of water within it moves in a curved path or orbit, and therefore it is subject to the same laws as the flywheel. Like the flywheel of a gyroscope its orbit tends to remain fixed in space. If one tries to divert it from its natural course it curves sideways instead of yielding directly to the opposing force.

Let us imagine, for a moment, that the drops of water within a single orbit in an eddy form a rigid hoop or wheel revolving freely within a loose frame. How will the wheel be affected by the rotation of the earth?

When it first starts to spin, the wheel is lying flat on the ground, its surface horizontal, its axle vertical and so not parallel to the axis of the earth. As the earth rotates, the wheel, responsive to the first law of gyroscopic action, tends to keep the direction of its axle fixed in space while the earth turns under it. This causes the eastern side of the wheel to begin to rise from the ground, just as a sunbeam rises above the horizon in the morning. But the weight of the wheel pulls it down. This pressure tends to tilt the wheel from west to east, out of its original direction.

Because of the second law of gyroscopic motion, this west-to-east pressure causes the wheel to pivot sideways at right angles to that direction, so that either the northern or the southern side of the wheel rises from the

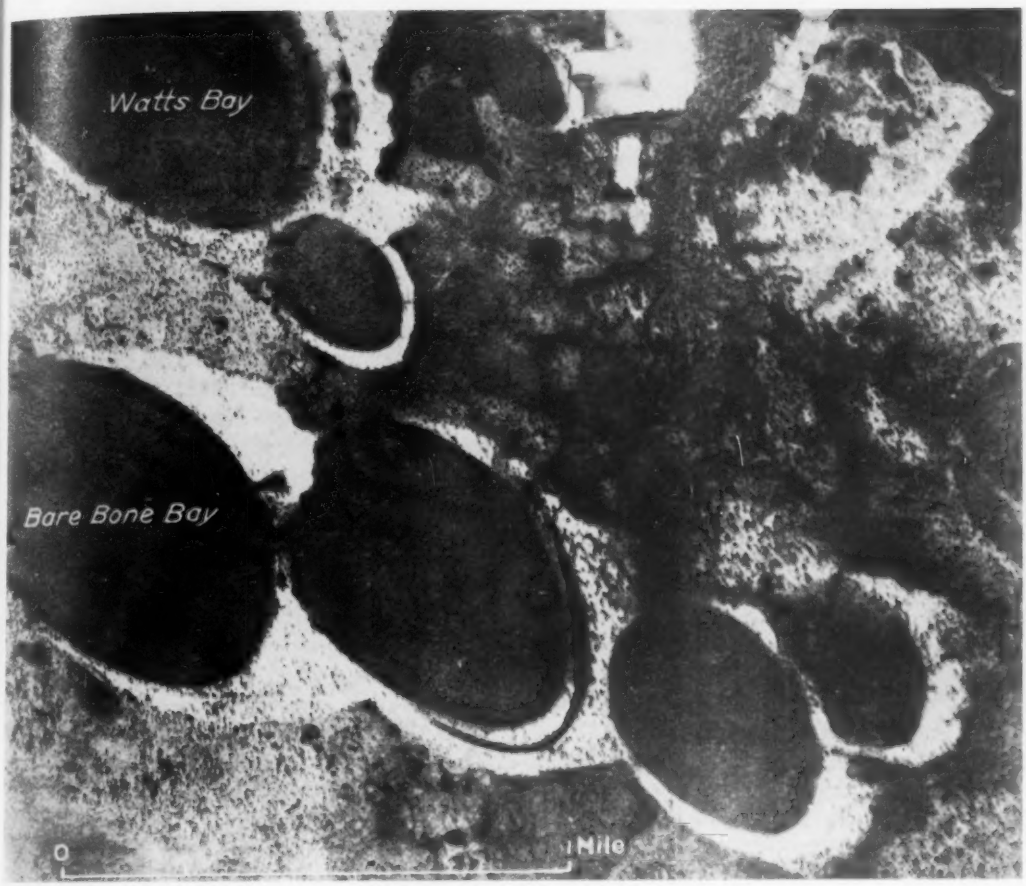

FIG. 3. GROUPS OF SAND RINGS 10 MILES NNE. OF MYRTLE BEACH, S. C.
THEY SEEM TO RECORD THE OUTLINES OF TANGENT EDDIES IN ONE OR TWO BODIES OF WATER. SAND BLOWN FROM THE SHORE OF BARE BONE BAY HAS ENCROACHED ON ADJOINING BAY. ALL THE RINGS ARE ELLIPTICAL.

ground instead of the eastern side, against which the pressure of gravity is at first applied. But this pivoting, also, is resisted by the weight of the wheel. So the axle sets itself parallel to the axis of the earth (about which it is forced to revolve), just like a gyroscopic compass with its axle pointed at the North Star. If the wheel were propped up in this position, steeply tilted to the horizon, it would offer no further gyroscopic resistance but would be carried freely through space by the daily rotation of the earth.

But the drops of water in the orbit are not propped up; neither are they rigidly connected. They instantly collapse under their own weight. The circular tilted orbit, flattened into a horizontal plane, becomes an ellipse of definite proportions, which vary with the latitude, the altitude of the North Star.

If the beach of the lake is sandy, if the longshore current is strong and persistent, the beach will gradually assume the shape of the eddy; for the dashing waves will loosen and pick up sand, which the current will redistribute over the bottom, dropping it along its course. Wherever the current leaves the original shore a sand bar will follow it out and may ultimately completely encircle the eddy. In this manner the elliptical course of an eddy, which vanishes when the current stops, may be perpetuated in the shape of bars and beaches.

Many of the sand rings in the Carolina bays appear to have been constructed in this way. The perfection of their symmetry is too great to have been wrought by ordinary wave action, undirected by Gyraea. Moreover, the proportions of the best-formed rings are almost identical with those of a theoretical eddy at the same latitude. In fact, of twelve rings that have been measured, the average deviation from the theoretical proportions amounts to only 0.35 of one per cent, and not one of the twelve differs by as much as 10 per cent from the ideal shape. Considerable individual variation is to be expected, for the theoretical ellipse is merely the limiting shape to which the sand bars should approach, and few could be expected to attain perfection. Some of the rings bulge out a little toward the east, as if strong waves had attacked the shore more vigorously on that side than on the other. The opposite side conforms more closely to an ellipse.

So much for the shape of the rings, which resembles the theoretical shape of an eddy. What about the orientation, the direction in which they extend? Does that, too, fit the hypothesis of rotating currents?

Let us return to the revolving wheel, the materialized orbit, which we left with its southern side propped up so that its axle pointed at the North Star. When we remove the prop, the weight of the wheel pulls downward, but instead of tilting downward the obstinate axle circles (precesses) sideways (eastward or westward) just like the axle of a gyroscope or a leaning top. This movement throws the axle out of alignment with the axis of the earth. The wheel again offers gyroscopic resistance to being moved by the rotating earth. It sidesteps again, this time tilting northward or southward, for the pressure is downward on the eastern side. This northward or southward precession turns the axle back into alignment.

Thus is set up a rapid alternation of tilting around a north-south line and tilting around an east-west line, which results in an apparent tilting around a diagonal line bisecting the angle between them. In the Northern Hemisphere this diagonal proves to be the northwest-southeast line; in the Southern Hemisphere it is the opposite.

So the ellipse formed by the collapsed circular orbit in an eddy extends northwest-southeastward, exactly the trend of the elliptical sand rings in the Carolina bays. The orientation as well as the shape fits the hypothesis of circulating currents.

The skeptic may point out that winds have been blowing across lakes, off and on, since time immemorial, yet most lakes are not elliptical nor are they all elongated in the same direction. If Gyraea is really an all-pervading force, why are not evidences of her work more prevalent? The answer is that her strength is intermittent. Sometimes she is powerful, sometimes impotent. When the current of an eddy ceases to flow she vanishes. Moreover, storm waves in an hour may destroy structures that have taken weeks or months to perfect. To work effectively she needs very unusual conditions; to preserve her works rapid changes in environment are required.

What are those conditions? Let us peep into the past. Turn back the calendar some 50,000 years to the beginning of the last important glacial epoch of the Great Ice Age. What was the country like when the sand rings in the Carolina bays were born? Let us watch it in its travail.

The "low country" has just emerged from beneath the ocean. We find it (and so it remains) a nearly level, sandy plain, featureless except for lakes of many shapes and sizes that fill shallow hollows in the old sea bottom. Here and there are straight or curving sand bars, which dam the water into long lagoons behind them.

Beyond the distant mountains lie great ice sheets that cover Canada and extend far south into the States. This huge cold blanket extending into warm latitudes sets up convection currents in the air. Strong gales blow persistently. Dark clouds of dust, rock powder ground by the glacier, rise from the flood plain of the Mississippi and settle in a thickening wedge of loess on the region east of the river. Little or no dust falls in Carolina, however, for no rivers from the glaciers cross the mountains. But persistent winds blow from the west and heap up sand on the eastern shores of the lakes.

The wind blows across the lakes. The

horses of Neptune rise on the water, shake their manes, and trot along the beach. First a trot, then a gallop. The clear, clean water near shore, stirred by the glancing waves, begins to move, keeping pace with the horses, whose keen hooves cut deep into the sand. As the water begins to eddy Gyraea takes the reins and holds them ever more firmly as the current gathers momentum.

Round and round the water circles. How fast it goes is anybody's guess. A speed of only a mile or two an hour will slowly distribute sand kicked up by the waves, but a faster current is very much more effective. Three or four miles an hour certainly is not excessive. An even faster rate is possible though hardly probable.

The waves cut into the beach, and the current drags off the settling sand to drop along its path. A curving bar builds out from the shore. As time goes on the shape of the circulating current becomes more apparent. The bar grows higher and higher and may nearly reach the surface. Waves break across it, carrying sand, which may fill in the space between the bar and the shore.

Look there! A blade of sedge grass. And there's another. Soon the shallow lake is thick with grass. The waves no longer wash the shore; they cease to build, nor can they now destroy. The grass grows on, and other water-loving plants move in to keep it company. Year after year the cast-off leaves accumulate to form a sodden mass of muck or peat. The lake no longer is a lake. It has become a bog or cypress swamp. In the parlance of the "low country," it is a bay.

Thus, I imagine, were formed the oval sand rings in the Carolina bays. No cataclysmic visitor from outer space, no comet in its headlong flight around the sun took part in their creation. Instead, they are the normal product of ordinary, everyday processes of nature, working, to be sure, under unusually favorable and rare conditions. The steady, constant wind, the washing wave, the longshore current are the tools. The new-born plain, the shallow lagoons and lakes, and the plentiful, loose sand were the materials from which were molded the mysterious racetracks. The mat of water plants is the protective barrier that shielded them from destruction.

So, when you fly by night over Carolina bays, perhaps you will imagine that you catch the glint of waves in the moonlight. As you begin to doze off to sleep, perhaps you may even detect the nebulous form of Gyraea, gauzy garments fluttering in the breeze, whirling around an oval racetrack in a Helix-shell chariot drawn by the prancing horses of Neptune.

THE PURDUE OPINION POLL FOR YOUNG PEOPLE[1]

By H. H. REMMERS

The obvious weakness of government by opinion is the difficulty of ascertaining it.—JAMES BRYCE.

Democracy needs accurate pulse-takers. It needs to check the whims, passions and vested interests of legislators and blackmailing pressure groups. It is possible that carefully conducted public opinion polls are the new and revolutionary technique in streamlining our horse-and-buggy democracy.—STERLING NORTH, Chicago Sun, July 23, 1944.

THE Purdue Opinion Poll for Young People is in some respects unique among opinion polls, notably in the fact that "consumers" of the poll pay for it as a service. It has no income except that obtained from the sale of the poll to the high schools in which it is conducted. Such continuous "consumer research" is a sound investment, if we may judge from the reaction of school administrators representing about 20,000 youngsters polled in five midwestern states last year. In what follows I shall sketch the purposes of this poll, its origins, how it is carried on, its accomplishments to date, and some of its future possibilities both as a service to the citizens of tomorrow—the high-school youth—and to social science in improved, scientifically validated methodology and techniques.

IN the immediate prewar period and undoubtedly in the postwar period all but a negligible fraction of our population of high-school age, for the first time in our history, were and will again be in high school. They will be responsible for carrying on the business of life tomorrow! It is, therefore, of great practical importance to obtain if possible a continuous inventory of their views on matters of common concern—government, education, economic enterprise, and cultural aspirations and values. Such a record of the public opinion of tomorrow can obviously serve a number of highly important purposes:

1. It can serve as a guide for evaluating the process of education in many of its important aspects so that ends and means of education in its broadest sense can be more effectively geared to each other.

2. It can serve as a catalytic agent and revitalizing force particularly in the social studies.

3. To the extent that dependable trends are obtained, extrapolations of such trends will constitute the basis for effective planning for the future not only in education but also in government and social arrangements generally.

4. It can serve as a vantage point from which to explore the origins of and the factors that change, make, and unmake attitudes, interests, wants, and needs of youth.

5. It can serve as at least a starting point for more effective community integration—community here being thought of not merely as the face-to-face social relationships of a relatively small geographic area, but as the state, region, nation, and ultimately the world community.

6. In the present wartime program it may serve as an important part of the psychological front.

7. It can make possible positive contributions to social psychology with respect to content, research methodology, and theory.

Public-opinion polls, such as those of the American Institute of Public Opinion and *Fortune* magazine and the previous polls of the Purdue Opinion Poll for Young People, have demonstrated the feasibility of validly polling the population with reference to important issues on the basis of relatively small samplings of the total population. The area of consumer research is rapidly demonstrating the same thing. There is a growing recognition of the fact that these samplings yield important and worth-while results.

When the surprisingly accurate election predictions of the Gallup Poll and of the Fortune Poll are recalled, based as these polls were in the 1940 presidential election on samples of 60,000 and 4,000 individuals, respectively, it will be seen that a sampling running to not more than three figures would

[1] From an address presented at the meeting of the Society for Social Research, University of Chicago, August 4, 1944.

constitute a much greater proportion of the youth of high-school age in question than the Gallup Poll of 60,000 was of the national electorate. The sampling error of even a few hundred is very small—of the order of 0.5 to 2.0 per cent.

Now these high-school youths, being in school for eight and one-half to ten months of the year, are much more conveniently available than are adults for purposes of polling. With the co-operation of high schools it is thus possible to obtain the required responses quickly and easily. These responses can at once be forwarded to Purdue University, where they can be immediately analyzed and interpreted.

In general the issues that are of widest and deepest common concern will be the objects of study. The responses to these issues will help educators and social scientists to know the climate of opinion in which our schools are operating. It is such attitudes of today's youth that will largely determine the course of the world of tomorrow.

The rationale of the poll having been conceived in this way, the first poll was financed without cost to the schools from the remnants of two research funds—one a grant for study of attitudes from the Josiah Macy, Jr., Foundation, the other from a large mail-order and chain-store concern, which had provided a fund to study the attitudes of the public toward chain stores.

For the first poll about 25 poll issues were selected by myself and my former assistant, R. L. Hobson. After running the gauntlet of the criticism of my seminar on the psychology of attitudes, these were administered to a carefully selected, controlled, or stratified sample of *schools* in terms of geographic distribution, political complexion of the community in the last presidential election, size of high school, length of high-school term, and the urban-rural ratio. For the detailed working out of this sample I am indebted to Lt. Melvin Davidoff.

The poll now has the services of an advisory committee composed of three "elder statesmen" of the University. They are Graduate Dean E. C. Young; Professor H. L. Creek, head of the English Department; and Professor J. A. Estey, head of the Department of History and Economics. After the proposed poll items have been tentatively selected and criticized by my seminar, they are sent to this committee for evaluation and criticism with reference to (1) public-relations implications, (2) importance of the item, and (3) possible ambiguities in phrasing.

On the anonymous poll sheet certain items of personal information are obtained: (1) place of residence; (2) sex, (3) political-party preference, (4) socio-economic status, and (5) grade of enrollment.

The item of socio-economic status ("home environment") requires explanation. It consists of the seven most valid items of the Kerr-Remmers American Home Scale and asks whether the home possesses a fireplace, a vacuum cleaner, an electric or gas refrigerator, a central heating system, an automobile, and a telephone and whether the family has had to accept relief or emergency work from the Government. A recent study based on home visitation, made by Gabriel Elias, graduate student at Purdue, independently validated these items as indicators of socio-economic status. The validity coefficient was of the order of 0.5, a value adequate for our purposes. Another bit of evidence consists in the fact that in such a school as Howe Military Academy all pupils without exception fall in the "better home" category two-fold classification of socio-economic status which we adopt for purposes of tabulation.

The results of the first poll were based on a sample of 4,300 high-school pupils in Indiana. A group of high-school principals and superintendents of schools engaged in a summer workshop at Purdue University were shown some of the results and asked whether they would be willing to pay for such a poll service out of school funds. Their reply was an emphatic "yes."

Thus encouraged we worked out the details of the program for a year's poll service (three polls), prepared the necessary promotional, descriptive material, and sent this to all high schools in Indiana, Illinois, Kentucky, and Michigan. In Ohio the Poll is operated for us by the State Department of Education chiefly through the interest in the venture by Dr. Ray Wood. As already in-

dicated, in these five states the last poll (1943–1944) was subscribed for for 20,000 pupils, a gain of nearly 700 per cent in one year.

Each school records its own results on tabulation sheets with required breakdowns, which we provide, and sends a copy to me. We combine the results under the appropriate headings and write an interpretative report, which is furnished each of the participating schools within about three weeks after the date of the poll. The schools then make the issues and poll results in service clubs and elsewhere.

WHAT evidence, if any, have we that the seven purposes of the POPYP previously listed are being met? Perhaps one should say first of all that not too much should be expected of a baby only two years old—or, if as in China the gestation period is included in reckoning age, a three-year-old baby. To what extent the first two purposes are achieved (evaluation of education and its

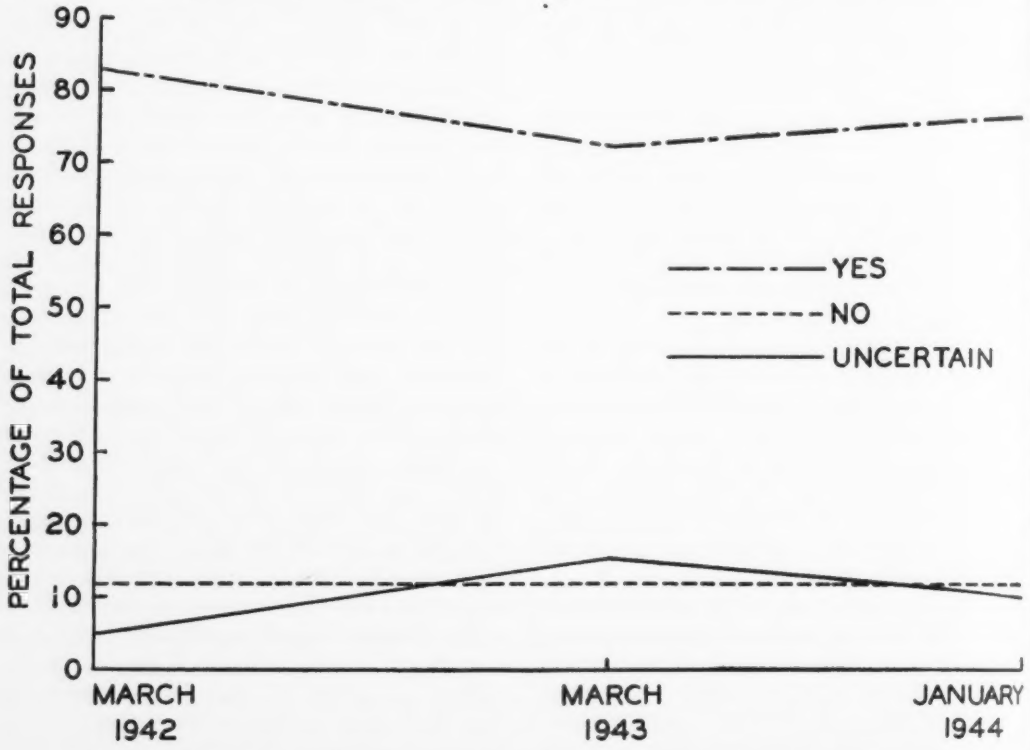

FIG. 1. RESULTS OF PURDUE POLLS ON FEDERAL SOCIALIZED MEDICINE
PROPOSITION: "OUR GOVERNMENT SHOULD ESTABLISH A PERMANENT SYSTEM OF PROVIDING MEDICAL SERVICE FOR ALL." RELATIVELY HIGH CONSTANCY IN OPINION INDICATED FOR THE THREE DIFFERENT POLLS RECORDED.

such instructional or other uses of these results and their retained local tabulation as suit their purposes. Most frequently, I have reason to believe, they have been used in classes on current events or current problems or other social-studies classes. But other uses are made of the results. In at least one Illinois community the poll served as a stimulus to the principal to poll the entire adult community, and there followed discussion of

vitalization particularly in the social-studies area) must be largely determined for the present from testimony of the teachers. Such testimony has been sent me by a number of teachers and administrators, but it is too lengthy to be detailed here.

Perhaps an appeal to the "face validity" (to use the jargon of test technicians) of the items would also be persuasive. For example, nearly three-fourths of the youngsters

agree to the proposition that "Most high-school students would like to discuss their personal problems with a sympathetic adult who would tell no one," but relatively few schools provide on their staffs professionally trained counselors. About the same proportion agree with the proposition that "Our Government should establish a permanent system of providing medical services for all," but only 50 per cent believe that "The age requirement for voting should be lowered from 21 to 18." Only 21 per cent agree with the proposition that "Relief and charity should be provided by personal contributions instead of by taxation." That these and similar questions constitute vital educational problems would be denied only by those fundamentalists in education who would restrict the functions of education to the three R's.

The achievement of the third purpose, that of determining shifts or trends in youths' opinions and attitudes, has some clear-cut evidence to support it. Our procedure for obtaining data has for the present settled down to having about one-fifth of the items on any one poll repeat items. For example, Figure 1 shows a relatively high constancy in the attitude toward federally sponsored socialized medicine on three different polls—March 1942, March 1943, and January 1944. A similar constancy holds for the attitude in two polls on military training after the war, as shown in Figure 2, and only slightly more fluctuation toward President Roosevelt's candidacy for a fourth term (Fig. 3). In Figure 3 there is also indicated a significant decrease in uncertainty over the period of a year (April 1943 to March 1944), with a somewhat corresponding gain in the anti-group. Issues that illustrate decided shifts in attitudes, on the other hand, are illustrated in Figures 4, 5, and 6, relating respectively to equal opportunities for Negroes and whites, desirability for postwar planning before winning the war, and the desirability of a world government. The decrease in racial tolerance during the period and the increased approval of postwar planning in the general population could be corroborated from a number of different sources. The rather sharp upturn in approval of a world government is undoubtedly related to school study, the press, and radio discussion of the issue.

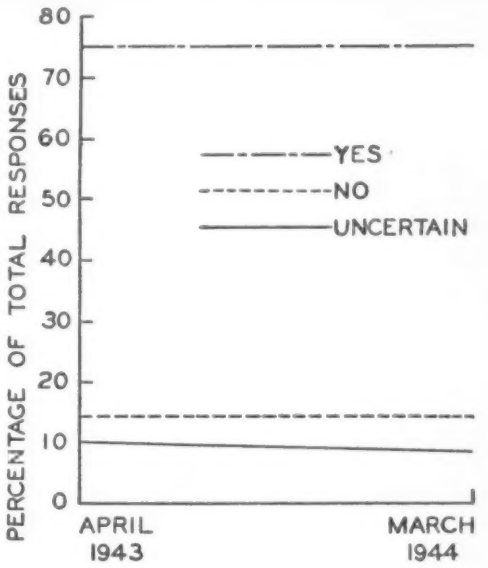

FIG. 2. MILITARY-TRAINING POLL
PROPOSITION: "SOME MILITARY TRAINING OF ALL ABLE-BODIED YOUNG MEN SHOULD BE CONTINUED AFTER THE WAR" (ALSO PUT IN QUESTION FORM).

The fourth purpose, to contribute to an understanding of the origins and growth of attitudes, already has the benefit of an extensive literature, which is steadily growing not only in quantity but also in its scientific

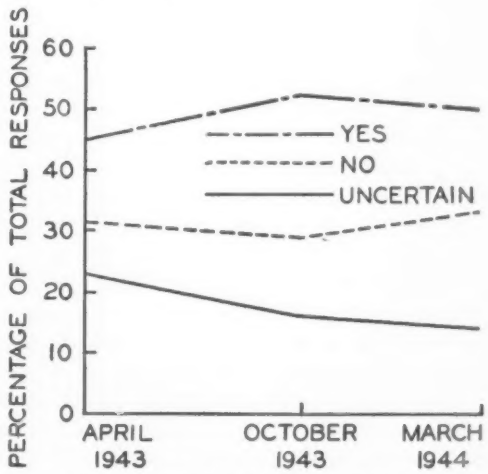

FIG. 3. FOURTH-TERM POLL
PROPOSITION: "IF PEACE HAS NOT BEEN CONCLUDED BY 1944, PRESIDENT ROOSEVELT SHOULD RUN FOR A FOURTH TERM" (ALSO PUT IN QUESTION FORM). ONLY SLIGHT FLUCTUATION IN OPINION INDICATED.

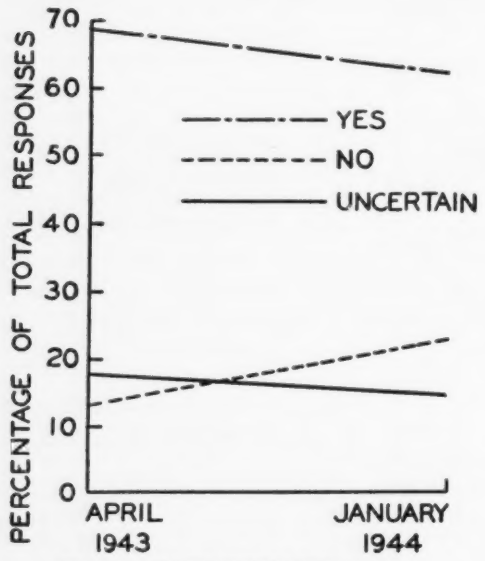

FIG. 4. RACE-EQUALITY POLL
PROPOSITION: "IF PEACE HAS NOT BEEN CONCLUDED ENTER TRAINED OCCUPATIONS ON THE SAME BASIS AS WHITE PEOPLE." DECIDED FLUCTUATION INDICATED.

rigor and dependability. Although in another series of studies (published in 1938 in *Public Opinion Quarterly*), my students and I have explored this area relative to the secondary schools, we have hardly made a beginning so far as the POPYP is concerned. These earlier studies of ours, however, and those of others provide a background and a springboard for new advances.

The fifth and sixth purposes—improvement of individual and community morale—must at present for their implementation rest upon hope rather than scientific evidence of their achievement. In a very real sense the use and application of poll results to the end of greater community morale is the most general and most crucial of the purposes to be served by the poll. Our society, locally, nationally, and internationally, has focal infection points of potential and actual tensions with reference to a number of well-known sets of values. Race, religion, and riches, as President E. C. Elliott has phrased it—these are the three R's to which education in its broadest sense must give increasingly rational attention. Riots, strikes, and political and economic discrimination are phenomena too well known to require description here. They consist psychologically of conflicts in attitude patterns. Here and there individual teachers and schools are attacking these problems by measuring the existing attitudes, providing instruction designed to change them in socially desirable directions, and remeasuring after such instruction in order to evaluate the procedure. I am not sufficiently optimistic to predict beyond doubt that we shall succeed in reducing such tensions to harmless proportions. There is, however, ample basis in both need and prospective success to warrant the attempt.

Finally, a study of the six polls thus far held on nearly a hundred different issues already leads to certain generalizations that contribute to content, methodology, and theory of social psychology. By way of example: Attitude patterns of rural and urban youngsters are more impressive because of their similarities than of their differences; the expressed uncertainties of ninth and tenth graders are significantly greater than those of eleventh and twelfth graders; youngsters from the better-home environment tend to be more liberal than those from the poorer-home environment—unless the issue presents what they interpret as a threat to their economic status; fallacious beliefs on "racial" biology are widespread and in

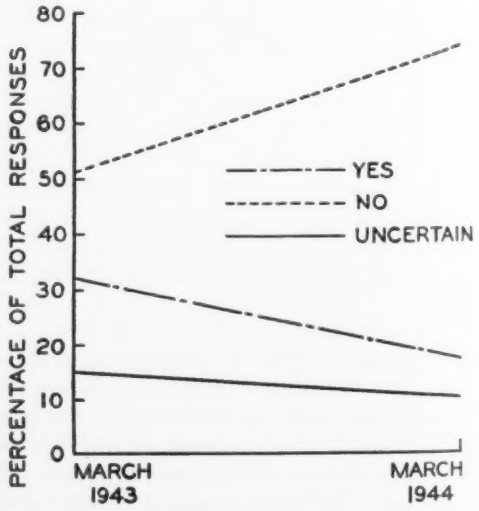

FIG. 5. POLL ON POSTWAR PLANNING
PROPOSITION: "WE SHOULD WIN THE WAR BEFORE PLANNING DEFINITELY FOR THE POSTWAR WORLD" (ALSO PUT IN QUESTION FORM). DECIDED SHIFTS.

the Midwest, at least, tend to increase in frequency of occurrence with increase in grade and age; a balanced question form is better than a declarative sentence in stating a poll issue; and so on.

The necessary statistical analysis required in interpreting the polls has already led to one mathematical paper, by I. W. Burr and R. L. Hobson, on the easy nomographic solution of the problem of significance of differences of proportions with a constant N (published in May 1943 in the *Journal of Educational Psychology*). As already stated, the index of socio-economic status used in the poll has been independently validated.

These and other positive achievements have been possible without any substantial financial assistance apart from the income from the sale of the service. Extension of the service and especially the research upon which to establish applications of the poll more firmly and to extend our understanding of the creature whose biological classification should emphasize that he is *homo patiens* as well as *homo sapiens* will require more support than this income provides. Some further financial aid, I am glad to report, is already assured.

If the usefulness of the poll is accepted as fact, it follows that its extension, possibly to a nation-wide basis, becomes desirable. On the basis of our experience thus far, particularly in Ohio, I am convinced that this will be most effectively brought about by working with and through state educational agencies—state departments of education, universities, or possibly in some states such professional groups as associations of high-school principals. This requires expenditures for travel, correspondence, telephone, and telegraph. It is not unreasonable to suppose that this extension could be accomplished within a year or less.

For purposes of discussion I have subsumed contemplated research under two general headings: methodological and social-psychological. These cannot, of course, be sharply separated. They are related in general as means and proximate ends. Following are some of the *methodological* problems worthy of attention:

1. *Anonymous paper-and-pencil polling vs. interview polling.* In the first published paper giving the general rationale of the POPYP I pointed out that a methodological study needed to be made "to determine any

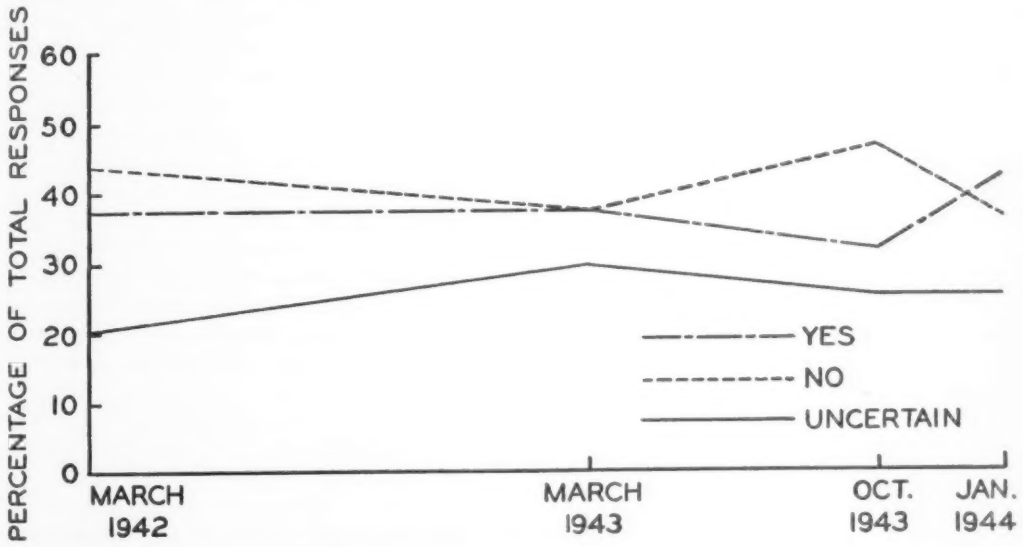

FIG. 6. POLL ON WORLD GOVERNMENT

PROPOSITION: "THE PEACE TREATY AT THE CLOSE OF THIS WAR SHOULD DISARM ALL NATIONS AND CREATE A GOVERNMENT OF THE WORLD WHICH IS STRONGER THAN THE UNITED STATES OR ANY OTHER NATION." THE DEFINITE UPTURN IN APPROVAL WAS PROBABLY DUE TO SCHOOL, PRESS, AND RADIO DISCUSSION OF THE QUESTION.

systematic variations as between interview results and classroom inventory results." In a recent visit to governmental agencies in Washington engaged in important attitude survey work on both the war front and the home front I found sharply divided opinions as to the validity of these two techniques in the study of attitudes and opinions. Their polling techniques varied accordingly, and there must have been a correspondingly sharp cost differential. Doubtless there is much to be said on both sides of the issue, but in the final analysis the quality of the pudding is determined by the empirical procedure of eating it. The problem is obviously one amenable to experimental solution in which high hopes and deep convictions have no place as criterion measures. In the study of adult attitudes toward chain stores previously referred to, three different mail-response techniques (i.e., paper-and-pencil) and the interview yielded no significant differences in results. They did differ very markedly in cost, however. (See articles by John W. Hancock and H. E. Geiger in the *Journal of Applied Psychology* for April 1940 and December 1941, respectively.) The cost of an experimental investigation for the high-school population would be insignificant as compared to a single year's expenditure on interviews carried out for similar purposes.

2. *Poll items.* From the earliest experiment on the psychology of testimony to the most recent public-opinion poll there is much convincing evidence that the form and content of items or questions are highly determinative of results obtained. What is the optimum form—declarative sentence, balanced questions, etc.—for a given population and for given purposes? In our fourth poll we carried out by means of a split-sample technique an experiment on this issue. The hypothesis often advanced that a positive statement tends to elicit a response of agreement was not supported in this experiment. Such experimentation needs to be continued and extended as a safeguard to valid interpretation of results.

As to content, poll items present the ubiquitous problem of semantics—frequently discussed under the heading of "loading" of items. The structuring not only of the attitudes in question but also of kindred attitudes as related to the wording of items, the introduction of contingencies, and the like will probably significantly affect responses. These problems are open to experimental attack.

3. *Reliability of measurement.* As a "consumer" of considerable technical literature on social-psychological investigations I find myself too frequently irritated and frustrated by the looseness of thinking and naïveté of interpretation of coefficients of correlation. A coefficient of 0.50 may in truth be a perfect correlation when the unreliability of the measurement is allowed for, and a coefficient of 0.80 may well fall far short of a true correlation of 1.00, again depending upon the reliability of the measurements. An imposing horror museum of examples could easily be established from the literature of the past ten years.

Fortunately the interpretations of opinion-poll data, since they are typically concerned with averages and proportions, are in less hazard than are many other types of experiments and investigations where the characteristics of *individuals* are at issue. Nevertheless, many of the problems I shall note later under social-psychological research are crucially affected by this issue, and the experimental design will frequently have to be such as to provide reliability data. Whenever the problem concerns the true relationship between variables, the reliability must be known. This issue obviously applies to both paper-and-pencil and interview methods of polling.

4. *Polling by radio.* An inquiry sent to a sampling of Indiana high schools recently revealed that a fairly large proportion of them have radios and do or could use them for classroom purposes. Testing the feasibility of polling by radio in co-operation with high schools is, therefore, an obvious and important experimental problem, particularly since Purdue University has the broadcasting station WBAA, and a radio discussion program built around the POPYP is now in operation.

5. *Evaluation of the* POPYP. This obviously presents problems of methodological

approach reaching all the way from collecting opinions concerning the value of opinions from pupils, teachers, parents, and possibly others, and their systematic study, to rigorously controlled experiments designed to measure behavior as related to expressed opinions and to changes in these opinions.

APART from answering the primary questions of the *what* and *how much* of opinions, *social-psychological* research relative to the Purdue Opinion Poll for Young People for the most part embraces the interrelations of attitudes and the relations between them and other variables. Some of the more pertinent and practical ones are given below.

1. *Residence—urban vs. rural.* Although there is persuasive evidence for the proposition that, in general, the psychological differences between country and city have within recent decades greatly diminished, this diminution is not equally great in all areas—taken either geographically or figuratively. Better psychological integration of country and city will result when we know the kinds of issues on which the differences are greatest and on which least.

2. *Sex.* On matters of common concern do our mores and public education produce different attitudes in the two sexes? Future research will have to discover what kind and how much.

3. *Political-party preference.* The structuring of politically related attitudes is of both practical and theoretical importance in a democracy.

4. *Socio-economic status.* Evidence has already been cited for the validity of our very convenient method of measuring this factor. Its relation to attitudes on attitude issues is likely to be of growing importance. It would be highly interesting, for example, to compare the results obtained in very exclusive eastern preparatory schools with those obtained in public schols and particularly in both city and rural slum areas. Serious social-psychological tensions if detected here could be a warning and guide for therapeutic action.

5. *School grade.* Our results give convincing evidence that pupils in the earlier high-school grades much more frequently mark issues as uncertain than do the juniors and seniors. The structuring, maturation, and growth of attitudes as affected by various factors obviously constitute an important and practical educational problem.

6. *Parents' attitudes as related to children's attitudes.* Accumulation of data under this heading would throw more light on the relative effect of home and other influences upon pupil attitudes.

7. *Knowledge about issues polled.* We have at present a study in progress designed to measure the relationship between racial attitudes and correct scientific information about races. This relationship between attitudes and knowledge is crucially important in many educational issues. When a social or abnormal psychologist talks about logic-tight compartments, the problem operationally defined is that of contradictory and logically mutually exclusive attitudes. Through this approach, then, we should gain insight contributive to the understanding of personality. Not merely knowledge but also attitudes as affecting ability to reason about issues obviously may be concerned.

8. *Teachers' attitudes.* It is generally assumed that teachers' attitudes are highly important in influencing attitudes of their pupils. The care with which teachers of both secondary schools and colleges and universities are chosen, particularly in the social studies, legislative enactments concerning things that teachers may or may not teach or discuss, the special loyalty oaths for teachers, of recent if not fond memory—all attest the validity of the assumption. The literature reveals only three or four experiments designed to test the hypothesis, and the answers are by no means unambiguous. Here is obviously an excellent opportunity to throw a great deal of light upon a problem affecting important public policy.

Teachers' attitudes should be investigated not only as directly measured but also as estimated by pupils, and the degree of agreement between these two determined.

9. *Parents' attitudes.* What has just been said concerning teachers' attitudes applies with equal propriety and force to parents' attitudes.

10. *Other attitudes.* Here the attitudes

toward some one area of society's concern such as economics, education, minorities, religion, and the like need to be studied in their relations to other such areas. In this sector we again approach the problems of the psychological integration of the individual personality, as well as that of groups. Only by knowing rather than making possibly shrewd but probably often fallacious guesses concerning these matters can the process of education of the oncoming citizenry be validly guided.

11. *Evaluation of the curriculum.* The organized materials, content, and procedures of the schools that we broadly call the curriculum need to be evaluated and validated with respect to their influence upon the attitudes that result from them. Public education, constituting as it does a system of social insurance, must be fundamentally concerned with the education of the emotions as it has never been before. Object lessons supporting this proposition have been given us in the form of fanatical young Nazis brought up in the *Hitler Jugend* and the school curricula of the Third Reich. For *their* education we are paying in lives, wealth, and stark human tragedy on a scale almost beyond comprehension. That even the lay public is coming to believe that the schools can do something about reducing racial tensions is attested by a recent very interesting letter of inquiry from a large industrial city's educational research bureau. It concerned the possibility of using the measuring devices developed by me and my students for making the teaching staff aware of existing racial tensions to the end of reducing them through systematic educational efforts. The inquiry was given special point because bloody race riots had recently occurred in the city.

Concerning the first five items in the foregoing list the Purdue Poll has already yielded much valuable information. Further analysis needs to, and I hope will, be made. Other of the various research areas indicated we shall tackle as means, opportunity, and, to some extent at least, interested graduate students are available. I am not, I trust, possessed of any delusion that the mere measurement of attitudes and opinions is a panacea for the social tensions from which we suffer. But I do assert that unless we are able to take frequent bearings with reference to these problems we can have little assurance that the ship of society is sailing in the direction of whatever proximal or ultimate destinations it may set for itself.

THE CHALLENGE OF SCIENTIFIC RUSSIAN

By JACOB CHAITKIN

THE scientific advances of the Soviets within the past two decades have aroused almost as much interest as their victories on the field of battle. Doubtless the two types of achievement are interrelated. What should interest us, however, is that, while the techniques of the Soviet military machine are military secrets, no mystery shrouds Russian science. Vice President Wallace, in the radio speech delivered on his return from East Asia (the "Pacific Era" speech), reported the eagerness of the Soviet scientists to co-operate with their American colleagues. The lively and fruitful exchange of scientific information between the U. S. Army Air Forces and the Soviets in the field of meteorology (*Time*, June 5, 1944, p. 92) is concrete evidence of this eagerness. Equally significant is the testimony of Eric Johnston, president of the United States Chamber of Commerce, regarding the Russians' admiration of American industrial techniques and the Soviet Government's expressed intention of developing trade relations with America after the war.

The only cloak of mystery that envelops Soviet science is that of the Russian language. Is this language a true barrier, or is it merely a psychological obstacle that we ourselves have conjured up?

The Russians do not permit language to form a similar obstacle in their study of our scientific work. English is taught widely in the schools of the U.S.S.R. and is treated as second in importance only to the native languages of that country. There is no psychological barrier in the Soviets' attitude toward the study of English. Perhaps we may put it this way: English is studied by many Russians because there it is considered easy; Russian is studied by few Americans because here it is considered difficult.

Let us concede at once that with regard to conversational and literary Russian the popular American attitude is amply justified. Not only is the Russian alphabet a bewildering experience for the average American, not only is Russian grammar strange and complicated, but also the Russian idioms are so numerous as to impose a staggering load on the average memory. After you have patiently learned to say, "I have a book," in Russian, having mastered the first person singular, present tense, of the verb meaning *to have*, and the form of the accusative for the feminine noun meaning *book*, you are told that the common Russian idiom disregards all this (in this particular connotation only) and uses an expression that literally translated means "by me there is a book," with the personal pronoun in the genitive form, *book* in the nominative, and *is* often omitted entirely. There is no doubt that proficiency in the use of Russian as a medium of conversation or writing can be attained only by long practice and study, preferably on the soil of the R.S.F.S.R. (the Russian Autonomous Republic).

Learning to read and understand Russian scientific writing is an entirely different matter. Many of the factors that make conversational and literary Russian so forbidding are absent in scientific Russian, and an impressive number of new factors, inherent in Russian scientific writing, come to the aid of the reader. In view of an impending era of Soviet–American scientific co-operation, these factors are worth examining. If scientific Russian can be mastered with relative ease, the American scientist may find that the Russian language is not a barrier but a sesame to the treasure house of Russian science.

I

The study of Russian begins with the alphabet, which is highly phonetic. Any Russian text may be read and pronounced with a fair degree of accuracy when one has mastered the meanings of the thirty-two symbols that compose the alphabet. With a few exceptions each letter stands for one sound and that sound only: if the English alphabet were based on this principle we should probably have fifty letters instead of twenty-six.

What makes the Russian alphabet confusing to the average student are the nine letters derived from the Greek. Needless to say, they are as familiar to the American scientist as the Latin letters of our own alphabet.

The *gamma, pi, rho, phi,* and *chi* are represented in the Russian alphabet by Г, П, Р, Ф, and Х. The first four have exactly the same value as the English *g, p, r,* and *f,* respectively, except that the *g* is always hard, as in *game;* never soft, as in *gem.* The Russian Х is pronounced like the German *ch* or the Scotch *ch* in *loch.*

The lambda Λ in Greek, appears in Russian as Л and corresponds to our *L.* The Greek delta, Δ, becomes the somewhat changed but still recognizable Д and is pronounced like our *d.* The Russian У is derived from the Greek upsilon, υ, and is pronounced *oo,* as in *tool* or *look.* Finally, the Greek iota, I, is represented in Russian by a double iota, И, and is pronounced like the English *ee* (double *e*).

It is patent that these letters hold no terror for the average scientist. In particular, he will not share the lay student's confusion as to the Russian forms of rho and upsilon, which are so frequently misread as the English *p* and *y.*

The rest of the Russian alphabet is fairly simple. The letters К, М, and Т are pronounced exactly as in English and are formed like the English capitals of these letters. А, the first letter of the Russian alphabet, is our broad *A* (as in *father*), i.e., like the *A* in every western language except English. In the lower case it is also formed like our lower-case *a.* The vowel О corresponds to the English *O,* except that it is pronounced like the *o* in *lord* (*aw*), never as in *so.* Our *S* is represented in Russian by С. Of course, we ourselves use *C* for the *S* sound as often as we do *S.* The only thing to remember about the Russian С is that it is never *K.* It is "Cimplicity" itself. Our *Z* is both printed and written in Russian like our script *z:* З.

The Russian Е is approximately like our *e* in such words as *there* and *pen,* but it is subject to two additional phonetic rules: (1) at the beginning of a word or following a vowel it is pronounced like the letters *ye* in *yes,* and (2) following a consonant it "liquefies" or "palatalizes" the consonant. Thus the word *net* will be read in Russian with the *n* sounding as in our word *news;* in *let,* the *l* will sound as in *bullion;* etc.

Our *b* is represented in Russian by a symbol that looks like our lower-case *b* but has a small horizontal stroke to the right of the stem at the top, thus: Б. In the lower case the stem becomes curved, thus: б. (All Russian capitals have the same form as the lower-case letters, with the exception of А, Б, and Е, which are а, б, and е, respectively.)

The foregoing eight letters are either identical with corresponding English letters or have common features that make learning easy. Two other letters are somewhat confusing but not necessarily so. They are the Russian symbols for our *V* and *N.*

The Russians use В to denote *V* and Н (our capital form only) to designate *N.* Even a most superficial knowledge of Spanish makes it easy to remember the Russian symbol for our *V,* in view of the affinity between *B* and *V* in Spanish. Confusion between our *H* and the Russian N may be avoided by this simple memory aid: there is no *H* (aitch) in the Russian language. *No h.* Remember this, and substitute the *N* of the word *No* whenever you see what looks like *H.*

Of the remaining twelve symbols, five represent sibilant, or hissing, sounds. In English these sounds are expressed by groups of letters. In Russian these combinations are so common that it was found convenient to devise special symbols for them. They are the letters Ж, Ш, Ч, Щ, and Ц.

Ж is usually transliterated in English as *ZH.* It is pronounced like the French *J* and is found in various disguises in such English words as *treasure, azure, vision, illusion,* and *invasion.* Ш is the English *SH.* The English *CH,* as in *Church,* is the Russian Ч. The combination of the last two sounds, that is to say, the *SH* and the *CH* (as in the words *ENGLISH CHURCH*) is expressed by the symbol Щ. Finally, the letter Ц is the equivalent of our *ts* or *tz* (as in *fits* or *Ritz*).

There remain seven letters, all of which are concerned with the "palatalization" characteristic of Russian speech. They are: Я, Ю, Э, Ы, Ь, Ъ, and Й.

Russian is a palatal or "liquid" language.

The "liquid" (for want of a better term) is the effect produced by raising the tongue toward the hard palate. Two of the vowels discussed above, the E and the И, automatically "liquefy" any consonant that they follow. (Thus, *Lenin* is pronounced with the *L* and the first *n* "soft" or "liquid"—the *L* as in *bullion* and the *n* as in *new*). The two other vowels described above, А and У, are so-called hard vowels but will be soft if written as Я and Ю, respectively. And, like E, these letters (Я and Ю) liquefy preceding consonants and are pronounced *Yah* and *You* when occurring at the beginning of a word or after another vowel. Е, и, я, and ю are the so-called soft vowels.

The soft vowels have the same general phonetic value as the corresponding hard vowels, except that the soft vowels are formed in the forward portion of the oral cavity, with the tongue slightly raised, while the hard vowels are sounded in the rear and without the intervention of the tongue. А is the hard counterpart of я, and у of ю. The Е, which is soft, has as its hard mate the vowel э. Like Е, the э sounds like the English *e* in *there* or *pet*, but it has no palatalizing effect and is never pronounced *yeh*. The rear vowel for the palatal и is the unique Russian ы. The Russians conceive it as paralleling our short *i* in *is* or *in*, but it actually sounds different. It may be produced by attempting to pronounce the German *ü* or French *u* without pursing or moving one's lips.

The symbol ь is known as "the soft sign." It is used whenever it is desired to palatalize a consonant without following it by a soft vowel. The soft sign is mute, can only follow a consonant, and is used exclusively to produce the "liquid." Ъ is called "the hard sign." It is used to separate a consonant from a soft vowel and thus to neutralize the "liquid" effect of the soft vowel. This symbol is found rarely and is quite unimportant.

The final symbol pertaining to palatalization is the й, which is used only after vowels and has the same value as our *y* in *boy*, for instance.

II

It is evident that the Russian alphabet presents no great difficulties for the English-speaking scientist. Eighteen letters are derived from the Latin and Greek. The remaining fourteen must be learned as a new experience, but some of them are extremely efficient devices for the representation of phonetic sounds. Bernard Shaw has suggested that we may well emulate the Russians by introducing similar devices into our own alphabet. The Russian symbol for *SH*, or some analogous symbol, would be particularly useful: English uses *s* for this sound in *sure*, *ss* in *Russian*, *sh* in *English*, *ti* in *nation*, *sci* in *conscience*, etc.

But the Greek derivation of a large group of Russian letters is only one of the many factors that facilitate the study of scientific Russian for our scientists. A factor of even greater importance is the abundant use of international and technical terms in Russian scientific material.

Not only are all mathematical, physical, chemical, and other formulas and equations in Russian scientific literature expressed in the international terms known to all scientists, but in addition the Russians are extremely hospitable to foreign terms derived from the Latin, Greek, French, English, and so on. Foreign words are frequently introduced as neologisms into the Russian language via scientific papers and texts. This is particularly apt to happen when a subject has been developed in detail in a foreign language: the terminology referring to that subject will be taken over freely. There is little trace of nationalistic sentiment that would favor the use of indigenous Russian expressions (possibly the federal nature of the Soviet political system and the existence of scores of official languages within the Union has something to do with this). As a general rule, international terms, easily recognizable by American scientists, dominate Russian scientific writing.

Here are some samples of expressions found on one page of a Russian paper dealing with physics of the air (the "soft sign" is represented by an apostrophe in this transliteration):

Maksimal'naya kontsentratsia ozona v atmosfere
Produkty kondensatsii
Gazovye molekuly
Kubicheskiye santimetry
Ul'trafioletovaya radiatsia
Radioaktivnost v troposfere

Would any American physicist find it diffi-

cult to understand this language, even without consulting the dictionary for the meaning of v (which is the preposition *in*)?

Of the indigenous Russian words used in scientific and literary Russian alike, many have roots in common with western languages. Words derived from such roots are easily retained in one's memory after they have once been found in the dictionary. For example, the root of the Russian verb *znat'*, meaning *to know*, is, of course, related to the *gn* in the Latin *cognoscere* and the many English words associated with that root. It is an easy matter to learn such Russian words as *znaniye*, meaning *knowledge; uznat'*, meaning *to recognize; znak, sign; znachit', to signify; oboznacheniye, designation; znakomit', to acquaint;* etc.

Not only do Russian roots often bear readily discernible similarities to corresponding western roots, but the mechanism of word formation is frequently similar to that in English. For example: the Russian verb meaning *to place* or *pose* is *stavit'*. The *sta* is, of course, related to the *sta* in the Latin *statuere*. And, as in English, the word becomes *compose, sostavit'*, when prefixed by the letters signifying *with* or *cum; substitute* or *podstavit'* when the prefix is the Russian preposition meaning *under* or *sub;* etc.

Hunting for common roots is a fascinating business, and one that bears rich fruit. There are few roots indeed that cannot be tracked down to at least dimly recognizable common origins. The Russian verb meaning *to divide* is *delit';* and, of course, one of the obsolete meanings of our English verb *to deal* is *to divide or share*. The Russian term for *besides, except, in addition to,* etc., strongly suggesting separation, is *krome* which is apparently related to the Greek *krinein,* meaning to *separate,* and to such words as *increment* (the purely coincidental *cream* is also a good memory aid). A wholly aboriginal Russian word for *sum* or *aggregate* is *sovokupnost'* from the root *kup,* which is actually related to our *coup* in *coupling*. There is an apparent affinity between the Russian words for 1, 2, 3, and our *one, two, three: odin, dva, tri*. These examples could be multiplied indefinitely.

The autochthonous Russian terms to be found in scientific prose without any visible affinity with western roots are comparatively few. Recourse to a Russian dictionary will not be necessary more often than in the case of, say, German.

III

The English-speaking scientist will not find the Grecian letters of the Russian alphabet difficult, nor will he be particularly baffled by the meanings of most of the words. However, to understand the author's meaning he must be able to recognize the grammatical form of the words and their function with relation to the structure of the sentence. This brings us to the consideration of Russian grammar and the third group of factors facilitating the reading of scientific Russian.

As mentioned above, Russian grammar is an intricate affair and usually is the most formidable hurdle of all in the study of Russian speech and literature. And here the reader of scientific Russian once more finds himself in a position of notable advantage.

For one thing, he is not interested in using Russian as a medium of expression for himself, but merely in learning the meaning of a Russian text. Since the general subject of that text is one with which he is thoroughly familiar, he can often guess the meaning or trend of reasoning without appreciating the fine grammatical construction.

One helpful factor of great value must be noted at the outset: scientific Russian is to a remarkable degree free from the idioms that defy grammar and make life so utterly miserable for students of conversational Russian. Russian scientists as a rule write a straightforward prose, without frills and with perhaps less recourse to idiom than scientists of other countries. Simplicity of style has always been one of the fine traditions of Russian science; recently this tradition has been strengthened by the consciousness of the requirements of readers in the non-Russian portions of the Soviet Union. Freedom from idiom is especially the rule in writings dealing with such subjects as engineering, physical sciences, mathematics, and medicine, where words refer to logical processes, natural phenomena, experiments, and the like, and there is little occasion to use

quaint turns of phrase. A different picture may perhaps obtain in the social sciences, where words are frequently more than vehicles for precise ideas and may themselves strut on the stage and become subjects of heated debate.

Remarkable opportunities for short cuts are presented to the reader of technological Russian in the study of the grammar itself.

Russian grammar, like Latin, is essentially a system of typical endings. One ending will denote a plural, another a singular; one the subject of the sentence, another the direct object, still another an indirect object, etc. An ending may consist of a large number of letters, and to learn the correct use of the language as a tool of expression all the various combinations of letters composing the endings must be studied. However, in many cases the very last letter of the ending, or perhaps two letters, will typify the construction of the word and give away the author's meaning. The reader of technical material, need only remember these last letters.

Again, if an ending has two variations, one of which is peculiar to one group of words and the other to another group, and if both variations connote the same meaning and function of the word, our scientist is not in the least interested in learning what particular words require the first variation and what words the second. Thus an enormous amount of time and effort is saved.

A good example of this short cut is found in connection with the two conjugations of the Russian verb, which form one of the veritable bogies of Russian grammar. A verb is said to belong either to the first conjugation, and has one set of endings in the present tense, or to the second conjugation, which requires a different set. This variation is the despair of students, since there is absolutely no way of knowing which verbs take one set of endings and which the other, *i.e.*, whether a given verb belongs to the first or the second conjugation. To the scientific reader this is irrelevant. All he needs to know is that both endings refer to the same construction.

As regards the verb it is altogether superfluous for our scientist to study the endings of the first or second person singular or of the second person plural. It is difficult to imagine under what circumstances these forms would be employed in scientific prose; even in a foreword the personal note of acknowledgement, in Russian papers, is usually couched in terms of the third person: "The author thanks, etc." The only forms used in a scientific text are those of description, third person singular and plural, together with the occasional use of the first person plural: "We regard, point out, examine, etc."

The endings of the future and present tenses are quite similar, there being other simple indicia for distinguishing the future from the present. The endings of the past tense are practically invariable. The imperative for the first person plural ("let us examine, regard," etc.) is identical with the form of the future tense, being distinguished only by the omission of the personal pronoun "we." The subjunctive is identical with the past, except for the addition of a Russian equivalent for "would."

It follows that, with the Russian verb as a whole, the reader of scientific Russian need learn only about half as many variations of the ending as the student of speech.

Nor does the advantage of our scientific student end at this point. Amazingly enough, he will experience little or no difficulty with that renowned stumbling block of Russian grammar, the irregular verb! This comes about in a curious fashion. Russian verbs are a jungle-growth of irregularities. Without rhyme or reason, the root of the verb exhibits so-called permutations or consonant changes in the midst of the conjugation. A *k* in one grammatical form of the verb will change to a *sh* in another, *zh* may change to *d*, *ch* to *t*, and so on. Since only the infinitive is listed in the dictionary, this frequently makes it impossible to find the verb. But it so happens that in almost all cases the irregularity occurs only in the first person singular of the present (or future) tense. And, of course, that is the form that is practically never found in scientific prose. In all other forms the verb usually remains regular, i.e., the root is the same as that found in the infinitive and therefore in the dictionary.

IV

In summing up it would be misleading to suggest that the study of scientific Russian is a "snap" undertaking; concentrated effort is required, and linguistic aptitude or acquaintance with other foreign languages is a highly desirable qualification. But the facts here presented demonstrate that the problem is much simpler than is generally imagined.

My own experience serves to confirm this conclusion. The length of time required to teach scientists to read Russian material in their own specialized field has been a fraction of that which elapsed before tangible results were obtained in "ordinary" Russian. Two or three lectures were required to teach the Russian alphabet and rudimentary rules of pronunciation to lay audiences (in accordance with the system suggested by me in *Esquire*, November, 1943), while one lecture sufficed to explain these matters to a special scientific group; and in both groups the students were equal tyros in Russian. But perhaps the best evidence in support of these views is the living example of a man who is the finest translator of scientific Russian I have ever met. He is employed by the War Department at the Pentagon Building. He does not speak a word of Russian!

Co-operation and friendship between this country and the U.S.S.R. are the indispensable prerequisites of lasting peace in the postwar world; nay, perhaps even of human survival on this planet. The scientists of the two countries are anxious to promote such friendship. It is comforting to know that language differences form no grave obstacle to any steps that our scientists may wish to take in this direction.

ELECTRA

A microgiant whose dendritic ends
Like Franklin rods alive, discharge the skin
Receptors, in specific range, to brain within,
One sheathèd cell electric signal sends.

To gland or muscle mass the neurones climb
In arcs direct of relayed as they start
Nor one impulse from other set apart
Save rate, or rhythm, amplitude or time.

Enigma!—how without a preformed code
This brain of trillion neurones came to know
A sight from sound, from taste, from touch, from smell.
Each signal bears no qualitative mode.
Is thought built out of action while we grow?
Are mind and action one, or can mind tell?

—JOHN G. SINCLAIR.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN INDIA

By V. S. SWAMINATHAN

A SMALL group of distinguished Indian scientists has recently visited the United States. They had a threefold object: (1) to cultivate fruitful contacts with scientific, industrial, and agricultural organizations in America; (2) to visit the leading universities to study how the nation's research laboratories are equipped and staffed, and (3) to see for themselves the most important industrial plants. What is envisaged is intellectual co-operation on the highest level. Science reached India from the West, and many of her ablest workers received their training in European and, more recently, in American centers of learning. The presence of the Indian Scientific Mission on the American soil focuses attention on the growth and present status of scientific and industrial research in India.

In ancient and medieval times India was ahead of Europe in certain branches of science, notably astronomy, mathematics, and metallurgy. But until recently she lagged lamentably behind Western countries in the teaching of science and the fostering of research. Today, considering the paucity of private endowments for research and the meager provisions made by the State for science teaching and specialist services, the output of original work from a number of India's eighteen universities and other independent institutions compares not unfavorably with that in the West.

The organization and progress of modern scientific studies and research in India falls into four fairly well-defined stages. The foundation in 1784 of the Asiatic Society of Bengal (ASB)—parent of all the Asiatic societies extant—forms a landmark in the history of arts and science in India. The objects of the ASB are to inquire into the history, civil and natural, the antiquities, arts, sciences, and literature of Asia. Among its early patrons were Warren Hastings and Cornwallis. The ASB has a long and brilliant record of achievement to its credit. On the scientific side alone its "Asiatic Researches" and "Journal" contain the result of the researches of Archdeacon Pratt on geodesy; Lambton of the Indian Survey Department; Voysey, "father of Indian geology"; Thomas Oldham, virtual founder of the Geological Survey of India; Falconer and Cantley, on the rich mammalian fossil fauna of the Siwalik Hills; Hodgson, on the birds and mammals of Nepal, Sikkim, and Tibet; Schwendler, one of the founders of the Calcutta Zoo; Roxburgh, "Linnaeus of Indian Botany"; and Colonel Dalton, on Indian ethnology.

The ASB is the parent and sponsor of many of the nation's learned societies and Government scientific departments. Its collections form the nucleus of the well-known Calcutta Museum. The Indian Zoological Survey is one of its offshoots. Above all, it organized and sustained during infancy the Indian Science Congress Association (modeled on the British Association for the Advancement of Science) and published the annual volume of "Proceedings" of the Congress meetings.

Early during the 'fifties of the last century the Universities of Calcutta, Bombay, and Madras were founded, and specialist science departments were instituted by the Indian Government from time to time. Today, India has eighteen universities, many of whose constituent colleges have science faculties with facilities—fair to excellent—for post-graduate research. The Survey of India might well be regarded as dating from 1767 when Clive appointed Major James Rennel as the Surveyor-General of Bengal. The Geological Survey was created in 1851, the Meteorological Department, and the Botanical and Zoological Surveys followed later.

Even so, the position of scientific teaching and research was unsatisfactory at the beginning of the current century for several reasons. Virtually all progress was due to official agencies and Europeans, and Indians doing original work were rare. As late as 1914 the bias was in favor of literary education to the detriment of science studies. India had no large-scale industries worth

mentioning, excepting cotton and jute and coal mines. The late Sir Francis Spring, referring to the country's river problems wrote: "More money has been wasted, for want of just such knowledge as a River Commission might provide, than would have sufficed to pay the entire cost of it many times over."

Only in 1917 was the Tata iron and steel works, thanks to American skill and machinery, in a position to make a real contribution towards World War I. The Indian Industrial Commission presided over by Sir Thomas Holland directed attention both to the desirability and necessity of establishing a system of organized research if Indian industries were to be adequately developed. In the years immediately following the last war little notice was taken of these recommendations. The only effect of the depression of the early 'thirties was that appropriations for the various science services and the Forest Research Institute, at Dehra Dun, were drastically reduced and many valuable schemes were shelved. It was not realized then that the main hope of recovery from the depression lay not in less, but in more, intensive research.

In 1930, however, the United Provinces Academy of Sciences was founded, largely due to the efforts of Professor M. N. Saha, F.R.S., the eminent astrophysicist, for the purpose of stimulating the spirit of research in the Allahabad, Lucknow, Benares, and Aligarh Universities. A similar service was done to South Indian universities when, under the lead of Sir C. V. Raman, F.R.S., and a Nobel Prize Winner, the Indian Academy of Sciences was established at Bangalore. In 1935, Sir John Anderson, then Governor of Bengal, inaugurated the National Institute of Science of India to promote scientific knowledge and serve as a national research council for prosecuting work of national and international importance. In 1937, the late Lord Rutherford in his presidential address, which he had prepared for the Silver Jubilee session of the Indian Science Congress, emphasized how greatly India would benefit by the formation of an organization like the Department of Scientific and Industrial Research (DSIR) in Britain. The present war provided the necessary stimulus, and in April, 1940, the Board and Council of Scientific and Industrial Research was set up by the Central Government. Sir Shanti Bhatnagar, F.R.S., India's short and dynamic physical chemist, was appointed its first director.

Private endowments for research in India have been few and far between. The Indian Institute of Science, with unrivaled facilities for advanced research in various branches of chemistry, physics, and engineering technology, owes its inception to the generosity of India's pioneer Parsi industrialist, Sir J. N. Tata. The National Chemical Laboratory at Poona is another virtual creation of Messrs. Tata and Sons, Ltd., who made a gift of $240,000 towards its construction, equipment, and upkeep. Handsome legacies left by Sir T. N. Palit and Sir R. B. Ghosh greatly benefited the University College of Science, Calcutta. Likewise, the technology section of the Andhra University is indebted to the munificence of Rao Bahadur D. Luxminarayan. The oil technology department at Lahore received great help from Messrs. Steel Bros.

Government- or State-aided departments, like the Imperial Council of Agricultural Research, the Indian Research Fund Association with its Nutrition Laboratory at Conoar, the Indian Cotton, Lac, and Jute Committees, the Central Bureau of Irrigation, the Irrigation and Hydro-dynamic Research Station at Poona, and the Ordnance Department Laboratories are doing very valuable work. A sum of $682,000 has been allocated by the Government for the establishment of a chain of research laboratories by the Indian Council of Scientific and Industrial Research to which the Tatas are adding another $600,000. The Board of Scientific and Industrial Research functions mainly through a series of nineteen committees, their activities ranging from vegetable oils to radio research. Investigations are carried out under the general control of the director in various university laboratories and at the Indian Institute of Science. Results are published in the *Journal of Scientific and Industrial Research* issued by the Council. This body has the opportunity of carrying out planned indus-

trial research on the many problems of chemical and metallurgical industries under tropical conditions. The establishment of the I.C.I. (India) Ltd. is assurance that chemical industries will be established in India.

The trend of scientific and, more especially, industrial research in India must obviously vary from what it is in Europe, for it must be based on available domestic resources and adapted to local conditions. India's endowment of minerals and metals is uneven. She has virtually inexhaustible iron ores (rich, high grade hematite and magnetite) and large reserves of the two tonnage ferro-alloying elements, manganese and chrome, as well as refractories like magnesite, dolomite, kyanite, and clay. But the reserves of coal, especially of coking quality, are strictly limited and have, moreover, a restricted geographical distribution. Thus the important provinces of Bombay, Madras, and Punjab lack this solid fuel. Hydroelectric development, though it has made rapid headway since the last war, is still in its infancy. The expert advice of the designing and planning authority of the T.V.A. scheme should give an impetus to India's power development. Oil from Assam and the Punjab is insufficient to meet the nation's needs.

Turning to base metals, India virtually lacks lead, zinc, and tin and is deficient in copper. There are, however, bright prospects for the light metals industry. The country has abundant salt, some potash and sulphur. In short, synthetic chemical industry in India must be based on different raw materials—say, oil in the Punjab and Assam; coal and limestone (calcium carbide and acetylene) in Bengal, Bihar, and Central India; sugar and molasses (alcohol, acetone, butanone, citric and gluconic acids) in the United Provinces and parts of Madras and Bombay; and cellulose. An Indian chemical industry based on oil, sugar, cellulose, etc., and water-power may, in the long pull, prove far more economical than the one based on coal tar. Many of the industries contemplated by the authors of the "Bombay Plan," as well as by the Government of India, depend on the development of electricity. Manufacture of electrical equipment and radio parts offers a vast and fertile field of opportunity.

Early in 1944, following the interruption of intellectual contacts by the war, the Royal Society of England took the unprecedented step of sending out Professor A. V. Hill, F.R.S., to convene one of its meetings in Delhi. As an index of the progress made by, and contributions of, Indians in the scientific field, nine have been elected fellows of the Royal Society: S. Ramanujan—mathematics; Sir J. C. Bose—botany; Sir C. V. Raman—physics; K. S. Krishnan—physics; Saha, Bhaba, and Chandra-sekhar—astrophysics; B. Sahni—botany; and Sir S. Bhaknagar—chemistry; and one had won the Nobel Prize. As a result of his Indian visit Professor Hill summarized India's four "musts" thus: (1) strengthening and extending the application of biology to agriculture, forestry, fisheries, pest control, animal and plant diseases, and public health; (2) better facilities for teaching and research in physics, chemistry, engineering, and metallurgy; (3) more accurate and comprehensive information on India's natural resources—minerals, water power, useful plants and animals, and labor and trained skills, and (4) more frequent opportunities enabling Indian workers to meet and exchange ideas with fellow workers abroad. He is emphatic that an adequate endowment of the learned societies of India would do more for Indian science, and hence for India's health and prosperity, than any comparable expenditure in other directions.

Today India is one of the major backward areas of the globe. She suffers from manifold maladies. Educated Indians realize that the nation's salvation must be sought through scientific and industrial research. The solution of the triangular complex of health, food, and population admits no delay. The nation's health standard is still low, corresponding to a mortality rate (at every age up to 55) four to eight times that of the United Kingdom and the United States. The amount and quality of food available is so poor on the average that malnutrition is widespread. Despite these twin handicaps, population is increasing fifteen per thousand, or 6,000,000 yearly. In his address as retiring President of the American Association for the Advancement of Science last Septem-

ber, Dr. Isaiah Bowman declared that "taking care of the huge surplus populations in lands like India and China, that now press on available means for livelihood, often to the actual starvation point, is an even more difficult matter."

To break this vicious circle, a group of Bombay industrialists produced blueprints of a 15-year plan to double the per capita income of the nation. They were, no doubt, impressed with the rapid strides registered by Japan in the industrial field during the early decades of this century, and the industrialization of Asiatic Russia in the last fifteen years. The Indian Government itself is working on a 5-year plan as a first installment of economic and social development, and has added a new Planning Department to the Viceroy's Executive Council. India would probably need to spend four billion dollars in securing capital equipment for her postwar industrial development. The report of the Indian Scientific Mission will have a vital bearing on the postwar economic progress of the country—the more so because it enjoys the confidence of the Indian public and the Government. Moreover, it has authority to place token orders for capital equipment in Britain and the United States.

A chain of well-equipped national research laboratories on various branches of pure and applied science, public health, and agriculture are abuilding, as well as several additional experimental stations and farms. Also, the Indian Government is considering the possibility of opening a central scientific office for mutual co-operation both in London and Washington. India is looking forward to an era after the war of progress in human welfare informed by science and inspired by research.

If these aspirations are to be translated into action, greater sums must, in the first place, be spent both by the State and by private industry on promoting research, on equipment, and on personnel. The next step is to ensure that they are expended to the best advantage. The political climate must be one conducive to united action—in other words, things are accomplished more quickly and with less friction under a popular national government. Lastly, in the economic development of the country as a whole, the Indian States cannot very well be omitted, since one can travel from Kashmir, in the extreme north, to Cape Comorin, at the southern tip, without virtually touching any of the British provinces.

SCIENCE ON THE MARCH

ECOLOGICAL ASPECTS OF POPULATION BIOLOGY

THERE has been considerable research interest of recent years in a field which may be properly called the "biology of populations." Attention has centered on the reactions of organisms considered as groups rather than as individuals, and findings of value are emerging. In addition to the demographers, who have long contributed significant data about the statistics of human populations, geneticists and ecologists have found this field productive.

No one interested in science has any difficulty in appreciating why biologists study, say, cells and organisms. Population or group biology, however, is a younger field and as such its existence and significance is less well known. The population adds a level of complexity above that represented by the organism. Since it is composed of many organisms, it seems to follow that a population has certain organismic attributes. In addition, however, it has a series of unique features, which emerge because it is a group-unit reacting as a whole within its effective environment. It is this latter phase that particularly interests the student of population ecology.

The integrating feature of population study is that these group attributes can be investigated and that, as the evidence accumulates, it becomes apparent that there are many similarities of structure and response between all types of populations. There are of course differences also, and these provide interesting and instructive avenues for exploration. But it is the essential similarities that give the population concept a meaning and make possible biological generalizations of considerable scope.

In the same sense that the geneticist is concerned with the transmission, physiology, and biochemistry of genes and the cytologist with the morphology and physiology of cells, so is the population student concerned in final analysis with the statistical consequences of reproduction (natality), mortality, and dispersion, and the pertinent environmental and genetic conditions that affect them. These are the factors that control population growth-trends.* Reproduction has the immediate potential effect of increasing group size; mortality, of decreasing it, and dispersion can function in either direction depending upon the form it takes.

As populations are studied it is seen that the various interactions of mortality, natality, and dispersion confer on the groups certain relatively regular patterns of growth. To cite an example, it is known that the growth of many populations can be represented by an s-shaped or sigmoid curve. The rate of growth is slow at first, increases rapidly, and again slows down, as the upper limit or asymptote is approached. This type of population growth constitutes a general phenomenon and is a subject for investigation. Progress has already been made in identifying the factors, functioning through natality, mortality, and sometimes dispersion, that produce this sigmoid growth curve.

A cogent argument for the reality of the population as an independent unit is afforded by instances in which natural selection, through its operation at the group level, has so affected interacting populations that their adjustment to one another has become adaptive and genetically fixed. In other words, under the influence of selective pressure the interacting species become (and have behaved as) a unit. Reference need be made only to the example of mutualism provided by the wood-feeding roach *Cryptocercus punctulatus* and its flagellate symbiotes, in which the roach furnishes a complete microhabitat for the protozoa while the latter produce cellulose-digesting enzymes for the host. This interaction is accompanied by appropriate physiological and morphological adjustments on the part of both roach and flagellate. For the development of a phenomenon of co-operation of this type, it seems clear that the population must have been the unit of selection rather than the

* As used here growth-trend refers to the entire course of a population's development. Actually, certain particular periods in the total life-history can be recognized: positive growth; equilibrium; oscillation; fluctuation; decline, and extinction.

individual organism. In short, this is a great experiment performed by evolution long before the biologist began to think about it. It shows that evolution "recognized" the existence of the population unit and "took advantage of it" as something worth exploitation! This same point can be made at the intra-species, as well as the inter-species, level. In malaria, for example, there is a well-marked population life-cycle with different forms in different environments, each adapted to the needs of the whole population, the population being the obvious unit upon which selection acts. Much of the phenomenon of the dispersal of parasites depends on the existence of populations rather than of individuals.

Numerous significant problems have engaged the attention of the population investigator. Space does not permit their discussion, but it seems appropriate to list below certain of the more important ones as guides to what has been, and what is being, studied. These, excluding an important set of problems that center in evolution and speciation and which are best taken up in conjunction with genetic studies, are as follows: (1) Descriptive, quantitative studies of population growth-form; (2) Analysis of population equilibrium; (3) The effect of various physical-chemical factors on population growth-form; (4) The problems of underpopulation, optimal population, and overpopulation; (5) Description and analysis of population cycles; (6) The problem of the optimal yield. (That is, to what extent can a population be exploited and still maintain itself? This is the problem underlying wildlife conservation.) (7) Analysis of group dispersion: immigration, emigration, and vagility; (8) Analysis of range and territory effects in natural populations; (9) Intra-species and inter-species competition; (10) The interaction of host and parasite populations; epidemiological aspects; (11) Analysis of social facilitation making use of population methods; (12) Improvements and extension of population census techniques; (13) The way factors interact to produce population integration. (This is the ultimate goal of population biology.)

The ecological aspects of the population problem fall into two general practical categories: studies of natural or field populations, and studies of laboratory or experimental populations. The former are concerned largely with analyses of population growth-trends and of the various factors that influence the observed patterns of growth. Thus, censuses are taken of various groups to determine, as first approximations at least, their size, density, and distribution. This may be followed by a survey of those local conditions that appear to be correlated with the census findings. For example, various meteorological factors in the case of terrestrial populations, and various physical and chemical qualities of the medium in the case of aquatic populations, are frequently shown, either singly or in combination, to affect the course of population growth. The quality, quantity, and availability of food is also another factor typically studied. Biotic factors too come under survey, notable among which are observations on predation, parasitization in its epidemiological connotation, and a number of intra- and inter-species competitions for such items as food, niches, mates, and so on.

Recently many students of population have turned to experiments in the field. This, when feasible, has certain advantages over the correlation method mentioned above. It yields data that are frequently more precise and certainly more interpretable, as can be illustrated by an actual example. An investigator was interested in certain forest-floor invertebrate populations of a characteristic Illinois farm woodland. He could have acquired not a little information about these by surveying the forms present; studying their natural history; estimating their abundance by quadrat sampling; recording the pertinent meteorological and biotic facts, and then fitting these items together to build up a story. This would constitute the conventional approach, and, if ably and comprehensively done by seasons for several years, would undoubtedly tell much about the population shifts as well as certain of the causal factors involved.

However, instead of following the above procedure the investigator chose to conduct a field experiment. He defined his problem somewhat as follows: If many boards of a certain size are placed on the forest floor to

provide a large number of microhabitats under specified conditions chosen in advance, what will be the faunal trends and major controlling factors that cause the species to move under, stay under, and move away from these boards? The advantage of this approach is twofold: it limits the problem in terms of analysis without destroying its generality, and it provides an experimental unit (the board) which can be manipulated according to a preconceived design. Of course, most of the basic data required for the conventional study are needed here, but, in addition, measurements of the micro-environment of the board-floor interface are taken along with regularized census counts. Also, the boards can be moved to other areas with or without transplanting the populations and alternate boards can function as experimental units while their neighbors function as controls. The results from such a program lend themselves admirably to statistical treatment, which further refines the conclusions and assists in spotting causal relationships. Field population studies such as this hold much promise and can be attempted for certain aquatic as well as for terrestrial communities. They are not a substitute for conventional ecological surveys, but are rather analytical extensions of such surveys. The investigation just described actually yielded a number of points of interest, some of which probably would not have emerged had the project proceeded along usual channels.

Experimental or laboratory population studies are grounded on the assumption that, since it is frequently quite difficult to assess population workings in nature, something can be gained when relatively simple population units are investigated in the laboratory under controlled conditions. An objection to this approach is that it may have a certain artificiality and, therefore, fail to contribute greatly to knowledge of field populations. A virtue is that the experimental approach facilitates an analysis which usually has a precision and interpretive value not possible to date in field work. The answer is, patently, that the two types of investigation complement each other, and eventually will draw together rather than apart. Also, by careful choice of species, project, and experimental conditions, it is frequently possible to deal with problems in the laboratory that are actually not artificial at all.

The *forms* that have been most studied in the laboratory are yeasts; various free-living protozoa; insects, especially granary beetles, fruit flies, chalcid flies, and certain of the social hymenoptera and isoptera; and, among the vertebrates, chickens, wrens, mice, monkeys, and apes. The *problems* most studied thus far have been, for populations of a single species, population growth-form, and the effect of population density on reproduction and mortality; and, for populations of two or more species, competition between two species for a common niche and food supply, and host-parasite and predator-prey interactions.

There is also an area of ecological population investigation which might be called the "theoretical approach." This, although not yet far advanced, is promising. In simplest terms it is concerned with the setting up of basic postulates about group interactions; reasoning, usually in mathematical form, as to what happens when the postulates operate in a particular situation, and, finally, testing the theoretical system by actual studies.

It is hoped that the above comments will provide a brief survey of an area of biological research which is "on the march" and which is contributing something worthwhile to general biological theory.—THOMAS PARK, Department of Zoology, The University of Chicago.

DIMOUT REVEALS SECRETS OF THE NEBULOUS ANDROMEDA

WHILE the allied armies with huge guns have been pushing back our enemies' frontiers in Europe and the Pacific, it has curiously happened that war restrictions have made it possible for astronomers to push back the frontiers of knowledge at 900,000 light years away.

A report from the Mount Wilson Observatory, detailed in the September, 1944, issue of the *Astrophysical Journal*, informs astronomers that Dr. W. Baade, using the 100-inch telescope, has resolved the nucleus of the Andromeda nebula into individual stars. This was a task that presumably was await-

ing the completion of the war-delayed 200-inch mirror of Palomar. All this became possible because of the dimout regulation that for months enshrouded Los Angeles and Hollywood in an unaccustomed pall of darkness. The absence of reflected light in the darkened California skies was reminiscent of the early days when Hale first established the Mount Wilson Observatory, and Los Angeles was but a growing town, while Hollywood had not yet scintillated with the stars of the motion picture world.

The darkened sky made possible prolonged exposure times, but this was not the whole story. Rapid advances in photographic plates made sensitive to red light, combined with a red filter in front of the plate, made possible further diminution of scattered light by which the ordinary blue-sensitive photographic plate is so easily fogged on prolonged exposure.

Another element contributing to the success of this remarkable discovery is to be found in the character of the stars themselves. Contrary to results obtained in some of the other external galaxies, the stars in the nucleus of the Andromeda nebula appear predominately red, as is evidenced from the results of Baade's research. The ability to photograph these stars at all means that the astronomers have been able to push the limiting magnitude of the 100-inch telescope one step further down the scale than has been thought possible. Heretofore stars of magnitude 21 have been the obtainable limit, whereas the present investigation has revealed stars two and one-half times fainter, or of magnitude 22.

The actual light band utilized in recording these individual stars was that of the narrow spectral region lying between 6300 and 6700 angstroms, as the spectroscopist would express it. The exposures were actually made on ammoniated Eastman 103E plates with the Shott RG2 filter to screen out the shorter wave lengths.

To arrive at some idea of the actual luminosity of these stars, it is necessary to express them in terms of absolute magnitude. This is the magnitude that a star would have if its distance were only 32.5 light years away. Our sun on this basis would be a star with an absolute magnitude of but little better than 5. The absolute magnitude of stars in the nucleus of the Andromeda nebula Baade found to be only little better than -1, whereas in some of the spiral nebulae the blue hot stars may be as great as magnitude -5 or -6. From the high color index, or redness, of these Andromeda stars their spectral type has been inferred to be K or M. One would presume that the Mount Wilson observers in attempting to assign a spectral classification on the basis of redness alone must have considered the possibility that the redness may be due to the scattering and absorption of blue light from dark cosmic dust in the region of the Andromeda nebula itself. Direct photographs of this spiral nebula would seem to supply evidence for the existence of absorbing material.

In any event, it is refreshing to know that in the darkest nights of war, new worlds, or perhaps one should say new suns, can be discovered with the help of wartime blackness.—HARLAN T. STETSON.

BOOK REVIEWS

GEOLOGY FOR EVERYMAN

Geology for Everyman. Sir Albert Seward. 312 pp. Illus. 1944. $3.25. Cambridge, at the University Press; New York, The Macmillan Company.

GEOLOGISTS in this country are becoming more and more aware of the need for an increasing dissemination of the facts of the science in terms understandable by the lay public. In his address as retiring vice-president of Section E, Professor Chester R. Longwell, of Yale University, dealt at length on the problem, particularly mentioning the need for nontechnical, interpretative books describing and discussing geologic phenomena. (*Science,* n.s., 101: 1–7, 1945.)

The English have long seemed to possess a special ability to produce works of this type. Many of the best have been written by men who are leaders in the science; the present work merits inclusion high on this list. Its author, the late Sir Albert Seward, was one of the world's most eminent paleobotanists, and for thirty years was a Professor in the University of Cambridge, a Master of a College, and a Vice-Chancellor of the University.

Despite the multitudinous duties thus falling upon him, he found time in his last days to write one of the most engaging accounts of geologic phenomena that this reviewer has had the pleasure of reading. Geology was Seward's first love as a student and an undergraduate, and the enthusiasm for the science remained with him throughout a lifetime of achievement. Into his book, completed but three days before his sudden passing, he has injected the accumulated satisfactions of his lifetime of geologic investigation in an expressed desire to show others the way to the same satisfying enthusiasm. Interwoven into an account of the geological history of England is a broad foundation in the principles of the geological sciences. Beginning with a simplified account of the geologic scene, as we find it today, the book deals with the history of the English area in descending order, proceeding from the better known to the relatively unknown, describing mainly the aspects of paleogeographic evolution and the orderly progress of plant and animal life. While the fact that the geologic illustrations are thus drawn very largely from the English scene may detract somewhat from the value of the book to the American reader, nevertheless the lucid explanations of geologic phenomena give the work universal value, and the author's felicity in the use of the written word imparts to it a high and delightful literary quality.

No comparable popular treatise in its field has been produced by an American author; our scientific literature will be greatly enriched when such a work does appear.—H. E. VOKES.

BEETLE ROCK

One Day on Beetle Rock. Sally Carrighar. 196 pp. Illustrated by Henry B. Kane. 1944. $2.75. A. A. Knopf, New York.

IN all the extensive literature of natural history, nothing quite like this book has been written before. In its accuracy of observation it yields no points to the animal stories of Ernest Thompson Seton which charmed another generation of readers, and its quiet, dispassionate style is reminiscent of Alan Devoe's little essays. But this is not a collection of stories about particular animals—literary field notes, so to speak—or summaries of the lives of our fellow creatures written by a writer who is at heart a moralist, no matter how impersonal he may try to be. This is the story of what might have happened in the lives of several creatures who are members of an animal community in a particular place (which actually exists, near the concession center of Sequoia National Park in the California Sierra) on a particular day, June 18.

Using the technique of the novelist who unravels the background of each of his characters in turn as they come together in time and place (as James Joyce did in Ulysses), Miss Carrighar has followed the animals of Beetle Rock on their individual but interrelated ways during that summer day. First we see the weasel on her predatory way, then the quiet, secretive day of the grouse, the chickaree's lively and impertinent antics, and the bear's comparatively sedate ways. Then there is a change of scale as the author takes us down to the lizard's level, and the whole inextricable tangle of life as it is lived by

creatures in nature becomes apparent to the reader. With a growing sense of familiarity with the scene the reader follows the coyote, the deer mouse, the Steller jay, and finally, the mule deer, in their wanderings across and around Beetle Rock. It is not a simple story, nor is it a sweet one from which to draw pious morals, for there is death and violence, fear and loneliness in it, but it is vivid and faithful to the facts. It all might have happened just as it is written.

There are two pitfalls which beset the writer of this sort of thing, but Miss Carrighar has adroitly avoided both of them. The first, which has laid many another low, is the pitfall of the purple passage. This is not to say that the book is not well written, for it is, but there is no excess verbiage to mire down the action. The whole pattern of action and description is so well balanced that it is hard to find a passage to remove from its context for quotation, and perhaps the opening sentences will do as well as any to give an impression of the mood and style of the book:

> The water of the brook reflected the sunlight up to an alder branch, where it flickered along the gray bark. On the fool's gold under the ripples lay a web of the sunlight, gently shaken. The sound of the current was subdued here, and the stir of the streamside leaves, and the Mule Deer was quiet too, as he moved slowly forward along the bank, clipping off willow buds.

The other pitfall is that far more insidious and dangerous one which is best described by the clumsy word anthropomorphism. The use of animal characters in moral fables is one of the most ancient traditions of literature, and Aesop and the Just So Stories have their well-earned place in our hearts, but they are not "natural" history. Yet many writers of nature books who have had no intention of emulating Kipling have come perilously close to putting human thoughts and reactions into their animal characters. Undoubtedly animals have fears and joys, and the difficulty is how to describe the subjective reactions of animals whose minds we have only the vaguest conception of without describing what our own thoughts might be if we were mice or birds or deer. While we cannot, without some communication with the creatures themselves, say whether or not Miss Carrighar has succeeded in her effort to describe their subjective reactions, it certainly seems as if she has. At any rate, they are kept to a minimum, and the traditional devices of the bedtime story are, of course, omitted. The result is that *One Day on Beetle Rock* is not only an honest attempt to describe wild life, it is a success, and the reader closes it with the impression that he himself has spent that day on Beetle Rock watching these creatures.—JOEL W. HEDGPETH.

POPULATION PROBLEMS

Enough and to Spare. Kirtley F. Mather. 186 pp. Illus. 1944. $2.00. Harper & Brothers, New York and London.

Demographic Studies of Selected Areas of Rapid Growth. Proceedings of the Round Table on Population Problems, 22nd Annual Conference of the Milbank Memorial Fund. 1944. $1.00. Milbank Memorial Fund, New York.

ANY discussion of power politics or the brotherhood of man should be based upon some consideration of the resources and the population pressure in various parts of the world. These two books provide a contrast of facts and fantasies in dealing with these problems.

Professor Mather has made a survey of world resources and population trends. He concludes that there is "enough and to spare" for all of the people of the world. According to Mather "the gloomy prediction of Malthus does not now apply and, if present trends continue, never will apply to man."

Since Mather is a professor of geology at Harvard University, his estimates of the mineral resources of the world should be reliable. He predicts that the world reserves of petroleum products should last until 2030, but, that coal and oil shales should provide adequate fuel for at least 3,000 years. Reserves of iron ore are estimated to be at least 5,000 times the present annual consumption. Similar optimism is expressed regarding reserves of most of the other metals and of mineral fertilizers. These estimates are based upon present normal demands for mineral products, the use of both inaccessible and low-grade deposits, and do not take into account the probable industrialization of the more backward countries—countries which contain three-quarters of the world population.

Mather's estimates of potential agricultural production and his conceptions of demography are unrealistic if not fantastic. Most competent authorities estimate that not more than 20 per cent of the land surface of the world is suitable for growing crops, yet Mather assures us that nearly half of the 52 million square miles of the land of the world can be made arable, with an additional 14 million square miles suitable for pasture. We are also told that "by putting into practice the techniques already known and utilizing the plant strains now available as a result of scientific breeding and hybridization, we can at least double and probably quadruple the out-put of our soil factory." Contrast this optimism with the estimates of Dr. C. E. Kellogg, Chief of the Division of Soil Survey of the United States Department of Agriculture, presented in Black's recent book *Food Enough*. He estimates that proper fertilization, along with other good husbandry, would raise crop yields in the United States about 25 per cent. We can have a permanent and increasingly productive agriculture, but we cannot expect miracles.

The declining birth rates of the Western nations are attributed by Mather to the natural consequences of man's evolution and "are due as much to physical factors of the human body as to the mental attitudes toward the bearing and rearing of children." The growth rates of the Occidental peoples are becoming stabilized, and the Oriental races are now entering this phase of declining fertility. As a result the world population will become stabilized long before there is any conflict with the Malthusian law. One wonders where Mather obtained his biological information regarding the causes of the decline in human birth rates.

The last four chapters of Mather's book are devoted to the interdependence of nations in relation to the resources of the world, and an appeal for the "wise use and equitable distribution of resources that are abundant enough for all." There are reasonable grounds for the author's optimism so far as the Western World is concerned, in spite of his naïve notions regarding agriculture and population growth, but the demographic problems of Asia are of a different order as we shall see in the following review.

Demographic Studies of Selected Areas of Rapid Growth is written by staff members and associates of the Office of Population Research, School of Public and International Affairs, Princeton University. The demographic problems of Japan are presented by Taeuber and Beal, of India by Davis, of Eastern and Southern Europe by Moore, of the Near East by Jurkat, and of Egypt by Kiser and Cleland. The problems of population policy are summarized by Notestein.

The population of Japan reached Malthusian equilibrium early in the 18th century and remained relatively constant until 1850. The impact of Western culture, foreign trade, and industrialization resulted in rapid population growth—56 million in 1920 and 73 million in 1940. Industrialization did not, however, raise the standard of living very high because much of the increased productivity was diverted to empire expansion and war. Sufficient advance was made to reduce death rates, but not enough to greatly reduce birth rates, which are still far beyond replacement levels. As a result Japan has a population which must expand to new territory or be held in check by high death rates.

The British brought relative peace and order, an improved agriculture, control of epidemics, and some degree of industrialization to India, but these gains have had little effect on the economic and cultural development of the people. Death rates have been reduced somewhat, but birth rates remain near the physiolocal maximum—about 45 per 1,000. The population, which includes nearly a fifth of the people of the world, is growing at a rate of 1.5 per cent per year.

The demographic problems of some of the countries of eastern and of southern Europe present the same picture—"Too many people, too little land." Agricultural methods can be improved, but cannot bring increased prosperity. Industrialization is needed. The Near East presents similar problems, although Turkey, Iran, and Iraq can support larger populations. In all of these areas birth rates remain high—in some regions over 50 per 1,000.

Egypt is not a critical area in regard to population size, but "the population problems of Egypt epitomize in some respects

those of the vast Mohammedan world"—high birth rates, limited room for expansion, and low living standards.

These demographic studies show the serious obstacles to future economic and political development in regions that are already densely settled and still have high birth rates—India, China, Egypt, Java, and other areas. The modern Western nations were able to avoid excessive population pressure by industrialization when the initial populations were relatively sparse, and at a time when there was no industrialization competition elsewhere. The increased economic standards led to artificial control of the birth rate and relatively stabilized populations. In this transition the populations increased several fold. Can the rest of the world make this transition without analogous growth or, if not, can they support such growth until the populations are stabilized? The answers are very pessimistic.

Notestein shows that population pressure cannot be relieved by high death rates because a rising mortality in these areas indicates rising population pressure and not a solution. "Emigration will not check growth in the most important areas of population pressure at the present stage of their demographic evolution," and "It would be unfortunate to waste the open spaces of the world in a fashion that could only intensify future problems of adjustment." He also maintains that population pressure cannot be relieved by birth control, because high mortality and subsistence living populations will not adopt contraception.

All of the authors are agreed that the growth rate of these densely populated regions can be controlled only by the improvement of the socio-economic conditions of the people. But gradual improvement of socio-economic conditions will reduce the death rate much faster than it will reduce the birth rate and will result in a rapid increase of population in areas already over populated. The industrialization of Japan may not provide an adequate basis for predicting the trends in other regions of Asia, but "if the same situation is to occur in the great overcrowded regions of the Asiatic mainland, the race between the expansion of economic opportunity and the accelerated population growth produced by mortality control would seem to be hopeless." There is hope for other regions, and Notestein suggests that the United States should attack the problems of its own colonial areas, especially those of Puerto Rico.

This book should be required reading for those statesmen who would plan a new world order.—KARL SAX.

THE ETERNAL PUZZLE

Consider the Calendar. Bhola D. Panth. 138 pp. Paper bound. $1.25. Bureau Publications, Teachers College, Columbia University, New York.

THIS is a scholarly work setting forth the difficulties in securing a workable calendar, the history of struggles with these difficulties, and some possible solutions. It is well documented, having numerous footnotes citing sources, as well as a selected list of references. Appendices deal with calculation of week days and holidays.

The lunar and solar cycles, and the more arbitrary but deepseated concept of the week, are reviewed. None of these units fits smoothly with the others. The ancient attempts to work out calendars from various standpoints, the comparative stability achieved by Julian and Gregorian reforms, and the bothersome irregularities even under the present system, are discussed. Various modern attempts have been made to work out a better fitting system of weeks, months, and years.

The author sets out weaknesses of our calendar and desirable points in a good calendar; regularity and simplicity are desired. Two systems are discussed at length as very promising. The "world calendar" has 12 months; there are 4 quarters of 13 weeks each, and each quarter has a 31-day and two 30-day months. The "international fixed calendar" has 28-day months, 13 of them, denoted by Roman numerals. In both there is an extra "stabilizing day" each year, and two such days each leap year. Other schemes have received less support. It is shown that in 1937 a number of national governments were favorable to the "world calendar." The author leaves no doubt that he favors calendar reform but does not express special favor for either of the two principal new systems.—F. M. WADLEY.

PROLEGOMENA TO AN INQUIRY INTO THE PROBLEMS OF MEDICAL CARE

American Medical Practice in the Perspectives of a Century. Bernhard J. Stern. xvi + 156 pp. 1945. $1.50. The Commonwealth Fund, New York.

THE profound socio-economic changes and technological advances of the past century have served to precipitate gradually in this country the recognition of a situation in which the medical needs of all sectors of the population are not being adequately met. It is well known that the chief immediate causes of these unmet needs at the present time are economic and geographic, since in many instances costs are beyond the reach of those needing medical assistance, and in many parts of the country such assistance is not available.

The situation constitutes a challenge. The effectiveness of medicine has been demonstrated and as a result there is a public demand for it. Unfortunately the extraordinary technological advances in the field of medicine have not been paralleled by the requisite advances in organization. Should adequate organization be provided by the medical profession and effect medical care within the reach of all members of the population, the profession need have no fears concerning the possible activities of other interested groups. On the other hand, if the profession approaches the problem with procrastination, trepidation or little thought, it is almost certain that the public will accept whatever type of organization that may become available as events swiftly move by.

Aware of the unsatisfactory situation with reference to the purchase and distribution of medical care, the Council of the New York Academy of Medicine established in the winter of 1942 the Committee on Medicine and the Changing Order. The Committee began its work in February, 1943.

The objectives of the Committe were defined as follows:

(*1*) To explore the possibilities and to formulate methods of maintaining and improving standards of quality in medical service, including medical research, medical education, the maintenance of health, both physical and mental, the prevention of disease, and the treatment of disease.

(*2*) To study the means of making available to larger groups of people and to the country as a whole the best known practice in preventive and curative medicine.

(*3*) To explore the possibilities and to formulate proposals of distributing these services not only to a larger number but also at a lower per capita cost than the present system permits.

The Committee, numbering 48 members, is composed of 31 physicians, one dentist, 3 nurses, and 13 laymen representing labor, industry, law, social work, and the clergy.

To orient itself to the different aspects of the problems which it was studying, weekly meetings have been held by the Committee at which experts from diverse fields presented their interpretations of the social and economic changes that were taking place.

Furthermore, the Committee, recognizing the need for objective data, early enlisted the co-operation of a number of experts in the preparation of a series of monographs on the reciprocal effects of medicine and the technological, social, economic, and political changes that have taken place in American life. The Committee believes that such monographs will offer not only a survey of the present situation but will also indicate its evolution and possible future trends. Thus, achievements as well as the inadequacies in medical practice will be revealed.

In addition to the publication of the monographs, the Committee intends to issue a report presenting any conclusions that might be drawn from its deliberations and studies.

The present monograph by Dr. Stern constitutes the first of the series to appear. Other studies to follow include *The American Hospital; Medicine in Industry; Rural Medicine; Varieties of American Insurance and Prepayment Plans for Medical Care; Medical Education; The Development of Community, State, and National Public Health Services; Preventive Medicine; Nursing; Medical Research;* and *Dentistry.*

Dr. Stern set himself the task of presenting a history of medical practice in America in its relation to various recognizable social, economic, and technological forces. It is admitted that this method of treatment definitely tends to lose much of the glamor usually found in medical history treated as

something isolated and far removed from reality. But much is gained, since an attack on a broad front is more likely to reveal the genesis of the various controversial problems, and thus provide some of the prerequisites, for their solution.

The different operating forces that have acted upon each other to bring about the situation of today are presented in the monograph under seven headings and an appendix, as follows: I. Social and Economic Changes in American Life, II. The Expanding Horizons of Medicine, III. The Specialist and General Practitioner, IV. The Supply and Distribution of Physicians, V. The Patient Load in Medical Practice, VI. The Income of Physicians, VII. The Distribution of Medical Services, and Appendix, The Effect of Recruitment on the Supply of Physicians in Civilian Areas.

Dr. Stern has performed well with his assignment. The monograph is no mere collection of events with appropriate dates, but a fresh, frank, integrated, and impartial history of ideas, well documented, concise, scholarly, and well written. The author shows that the present inadequacies in medical practice stem from a complex of factors each influencing the other. Among these factors mention should be made of the urbanization and industrialization of society, development of scientific medicine, centralization of scientific medicine in the hospital, increasing demand for medical services, rising costs of medical care, distribution of medical care, development of medical specialties, and geographic distribution of physicians.

The reviewer was particularly impressed by the author's emphasis on the shifting of the focus of medical practice from the disease to the patient, and on the close relation between individual welfare and social welfare.

The author concludes with the statement that "the problems of medical practice that are agitating the public today are . . . primarily concerned with the provision of a high quality of curative and preventive medical service to all the people, whether they belong to low or high income groups, whether they be rural or urban residents, Negro or white."

The book is adequately indexed, and the typography and binding are of good quality.

The Committee on Medicine and the Changing Order of the New York Academy of Medicine is to be heartily congratulated for having initiated a very much needed and particularly worthwhile evalution of ideas. Should the succeeding monographs measure up to the quality of the present one the Committee should find the task of preparing its final report considerably lightened.

The reviewer recommends the monograph to all persons interested in the problems of medical care; those who read it will look forward with keen interest to the appearance of the later monographs and particularly to the final report of the Committee. May the report be bold and state clearly not only what the Committee believes medicine with its diagnostic, curative, and preventive services should perform, but also the elements of an adequate type of organization to accomplish the objectives.—W. M. GAFAFER.

COMMENTS AND CRITICISMS

Omission

I wish to call attention to the omission of a line in copying the quotation from Browne's *Source Book of Agricultural Chemistry* in the review of this work by Dr. Mark Graubard, in the January 1945 number of THE SCIENTIFIC MONTHLY. On page 79, second column, second line from the top, the passage in the Source Book reads "Mayow [Hales and their followers focussed attention upon air; Stahl and his school] emphasized the importance of the fire element or phlogiston." The line of the *Source Book* left out in the review is marked in brackets. The occurrence of an omission in the citation is obvious, for Mayow died over thirty years before Stahl announced his theory of phlogiston.—C. A. BROWNE.

Social Sciences, Too!

The sciences of interpersonal and intergroupal relations are on the verge of becoming reputable natural sciences, if they, or at least some of them, have not already done so. Their development is increasingly away from philosophy and literature and toward the rigorous, carefully delimited and controlled investigations of the physical and biological sciences. Social scientists in the near future will be as dependent upon mathematical and instrumental research procedures as physical and biological scientists now are. It is increasingly evident that the "fields" of the physical-biological and social sciences are as overlapping and interdependent as the "fields" of the physical and biological sciences.

These facts require a much needed recognition of the unity of all natural science and underlines what is daily becoming more evident: if we do not learn how to conduct our social affairs in the spirit and by the knowledge gained from all the physical, biological, and *social* sciences, much of our physical and biological scientific knowledge will continue to be either not applied at all or tragically misapplied, or both, as is the case at present.

Sane postwar planning for science must not fail to include planning for the rapid transformation of social science into natural science. This means the complete elimination of *all* animistic modes of thought and action, societal behavior, and the maximum application of *all* scientific knowledge to the problems of world-community living.

The youngest child in the House of Natural Science may well become one of its most useful members if its older brothers give it the advantage of their advice and experience and insist that it never forget that if it is to be a science at all, it must be a natural science, too.

The SM is still the best magazine I take and I am glad the AAAS owns it now, lock, stock, and barrel. Your idea of scientific poems as end-of-article fillers is a good one. I have always contended that the old-time poetry-line has run out—we must have a poetry consistent with science, just as we must have a religion—or a system of ethics, if you prefer—that is not inconsistent with tested scientific knowledge.—READ BAIN.

Feline Fishermen

Should not Dr. Gudger's article on "Feline Fishermen" [February 1945] have begun with the tragedy of Selima, the "Favourite Cat Drowned in a Tub of Gold Fishes," celebrated two hundred years ago by Thomas Gray:

A whisker first, and then a claw
With many an ardent wish
She stretch'd, in vain to reach the prize—
What female heart can gold despise?
What Cat's averse to fish?

Presumptuous maid! with looks intent
Again she stretch'd, again she bent,
Nor knew the gulf between—
Malignant Fate sat by and smiled—
The slippery verge her feet beguiled;
She tumbled headlong in!

And the story of feline fishermen may go much further back. I think I remember that in the Latin version of Aesop there are somewhere a couple of lines to the effect that "The cat loves fish, but is unwilling to wet its feet." Perhaps some classicist can verify this, or trace the story still further. —W. F. BREWER.

On "The Brownstone Tower"

It seems to me that it would be a splendid thing if all of your readers who, like myself, have noted with pleasure and have rejoiced in the recent improvements month by month in the SM would take the time and trouble to write in and tell ye Ed. as much. There really should be more of that sort of thing done on general principles. However, it may be that I misjudge frail human nature.

Although there are a number of recently inaugurated features in the SM that are worthy of commendation, the latest new section entitled "The Brownstone Tower" has made a special and particular hit with at least one old subscriber. You are to be congratulated, not only upon the astuteness of the idea itself, but on the very interesting possibilities into which it very likely will develop. Definitely, its potentialities reach afar.

In the development from month to month of this

new feature "The Brownstone Tower," the thought has occurred to me that, in view of the fact that so many of your readers are students in remote locations who never have had the good fortune to visit Washington or to see and explore the old Smithsonian building, it might be a good idea for you to devote a bit of space now and then to telling these unfortunates more about the place where you work and the many other things all about you there of interest to students.

The Smithsonian building is of the Norman or Lombard style "of the latter half of the twelfth century. It is the latest variety of the rounded style, and it is found immediately anterior to the merging of that manner in the early Gothic. In general design and in most of the details the architect adhered to the period to which this style is referable. The general feeling, however, which permeates the design, especially in the upper towers, is that of a somewhat later era, when all lingering reminiscences of the post and lintel manner had been discarded and the ruling principles of arch architecture were recognized and carried out. The semicircular arch stilted is employed throughout, in doors, windows, and other openings. The windows are without elaborately traceried heads. The buttresses are not a prominent feature and have no surmounting pinnacles. The weather moldings consist of corbel courses, with bold projection. The towers are of various shape and sizes; and the main entrance from the north, sheltered by carriage porch, is between two towers of unequal height."

I realize that I may not be an entirely disinterested witness insofar as any discussion of the old Smithsonian building and its ornamentation may be concerned, for I dearly love the old place, and have long had a whole lot of sentiment tied up in everything pertaining to it. I admired pictures of it before I ever saw the place, and when I did get to see it some thirty odd years ago, it was a case of love at first sight. Later on for some ten or fifteen years or so I was secretary of a scientific society in affiliation with the Institution, and in that capacity I was in charge of that society's duplicate sale stock of publications stored in a large square room afar up in one of the south towers, and only to be reached through impressive iron doors and several flights of stone or metal stairs. I shall always remember with pleasure, many pleasant Saturday afternoons in summer spent by me working alone up in that old tower room assorting those publications at my table in a sunny window or in looking out the various other openings across the roof tops between the quaint objects of ornamentation down on the Government buildings and other things on the Mall, all of these more than usually interesting when viewed from such an unusual vantage place, or, perhaps in gazing down the Potomac through the haze toward Alexandria eight miles away, or toward Mount Vernon, Virginia, some sixteen miles away.

In those days I had a vague notion that perhaps I might write up these pleasurable impressions at some future time, but realized that probably I would not be able to do justice to the subject. If and when I ever did so, however, I thought as I looked out over the roof tops how appropriate it would be if I could somehow work in those wonderful opening lines from Sir Walter Scott's great poem "Marmion." You remember them. They run like this:

Day set on Norham's castled steep,
And Tweed's fair river, broad and deep,
And Cheviot's mountains lone;
The battled tower, the dunjon keep,
The loophole grates where captives weep,
The flanking walls that round it sweep,
In yellow lustre shown.

Anyway, if you now get as much satisfaction from use of your brownstone room as I did from mine in those days, you are to be envied.—J. S. WADE.

Lakanal and Chappe's Telegraph

It was with much interest that I read the very excellent article in your December number entitled "Telegraphs and Telegrams in Revolutionary France" by Duane Koenig. It seems to me, however, that the author should have put more stress on the part played by Lakanal in presenting Chappe's project and his success in securing the full support of the National Convention.

It is true that Gilbert Romme had, in April 1793, championed the cause of Chappe's invention, but soon after, he had become a prisoner in the Girondist uprising in the Department of Calvados. Arbogast was appointed in his place, along with Daunou and Lakanal as representatives of the Convention, to witness Chappe's demonstration of his telegraph. Daunou was a man of literary training and tastes, and Arbogast was a mathematician. Neither was particularly interested in the applications of science. From Chappe's letters to Lakanal[1] we learn the part played by Lakanal and the rather negligent interest of Daunou and Arbogast. Excerpts from the letters follow:

"It seems to me that Citizen Daunou attaches little importance to my telegraphic system. Citizen Arbogast displays the same indifference. . . . If you were not there, I would despair completely of success. You will remove the obstacles so much to be dreaded from the Committee of Finance, so unfavorable to everything that concerns sciences and letters. Finally, I am hoping strongly in you, and in you alone. . . ."

Cambon and Monot, members of the Committee of Finance, vigorously opposed financial aid to Chappe.

[1] *Exposé Sommaire des Travaux de Joseph LaKanal*, Paris, 1838. Pages 219–221.

They were interested in rigid economy, owing to the financial plight of the country. "What men this Cambon and his Monot are," exclaims Chappe. "I admire the courage and calmness which you oppose to their bad reasonings, to their insulting sallies against your Committee. The sciences will never be free of obligation for the services that you have rendered them. I beg you to be persuaded that my gratitude towards you will end only with my life. . . ."

"At last, thanks to your brave efforts, to your unalterable patience, my project will be examined upon a line of correspondence suitable for giving conclusive results. You have procured the funds necessary for this preliminary test. . . ."

In the following excerpt Chappe refers to an effective argument used by Lakanal. Before quoting the passage it may be well to explain that Montesquieu, and after him Rousseau and Mably, had all expressed the opinion that a Republic could be successful only in a small country. This idea was accepted by nearly all the Revolutionary leaders, although Brissot and Condorcet, who were familiar with the success of the Republic in America, did not share the common opinion. Since France had been forced by circumstances into the adoption of a Republican form of government, there were still many in the summer of 1793 who feared the experiment might fail owing to the large extent of territory covered by the Republic.

Says Chappe: "I learn from various representatives and from some employees of the Committee that Citizen Daunou does not want my project, and that Citizen Arbogast does not display any zeal for its adoption. How is it that they were not struck by the ingenious idea that you developed yesterday before the Committee, and of which I had not thought. The establishment of the telegraph is, in fact, the best response to the publicists who think that France is too broad of extent to form a Republic. The telegraph shortens distances and unites in some fashion an immense population about a single point. A long time ago, rebuffed on all sides, I would have abandoned my project if you had not taken it under your protection. . . ."

Lakanal's suggestion that the telegraph would make France a smaller country won over the Deputies of the National Convention in favor of Chappe. Recently we have heard a great deal about the increasing smallness of the world due to rapid means of communication, and the very title of the late Wendell Wilkie's *One World* is but an echo of Lakanal before the National Convention in 1793.

In a letter of thanks to Lakanal, Chappe says: "Thanks be unto you a thousand times! You have triumphed over all obstacles. . . . You have transformed them into ways and means; behold me fully satisfied. The project is adopted, and the decree determines my rank and my pecuniary privileges. . . ."

"I owe you new thanks. You are inexhaustible when it comes to being useful to me. I have received the decree of the Committee which puts at my disposition the funds necessary for a trial on a large scale. I am going to busy myself with ways of execution. I shall be very attentive to keep you abreast of all my operations. I pray the creator to accept the homage of his creature."

These extracts from Chappe's letters not only bring into relief the attitude of Lakanal in contrast with that of Daunou and Arbogast, but they show the deep gratitude of the inventor toward the one man to whom he owes his success.—JOHN C. DAWSON.

Approval

A hearty second to Dr. Stecher's motion, February issue, p. 165. The biographies should be put where they could be bound. You might number all the pages, including the advertising section, otherwise libraries simply won't bind those parts. I have had a feeling of loss and frustration at reading old bound volumes because of the absence of the biographies. I think this a very urgent matter.—H. L. STEWART.

Correction

The Popular Science Monthly was projected by Edward Livingston Youmans (1821–1887) and was for the first fifteen years of its life edited by him, although he was actively aided throughout this period by his brother, William Jay—not J. W.—Youmans. The first number came out in May 1872. It was issued just at that time to provide a vehicle for Herbert Spencer's essays on "The Study of Sociology." E. L. Youmans was a largely self-trained promoter of science rather than a scientist in the strictest sense of the word. William Jay Youmans (1838–1901) was educated as a physician and practiced for a few years at Winona, Minnesota. He returned to New York and worked on the *Popular Science Monthly*, writing articles on the advance of science, science education, and scientific applications. He became the editor upon his brother's death in 1887. As editor he included in almost every issue the biography of a scientist. Most of these sketches came from his own pen and about fifty of them were republished in a book entitled *Pioneers of Science in America* (1896). His editorial successor, J. McKeen Cattell, said of him that his life was "devoted with rare singleness of purpose to the diffusion of science," and that he was "gentle, kind, and noble." We should also remember with gratitude the sister of these founders of our journal, Eliza Ann Youmans, without whose aid Edward Livingston Youmans could not have done his work.—H. G. GOOD.

THE BROWNSTONE TOWER

Doubtless Hedgpeth's "Re-examination of the *Adventure of the Lion's Mane*" [March issue] was appreciated only by those who belong in fact or in spirit to "The Baker Street Irregulars," a large group of people who, having fallen under the spell of Sherlock Holmes and Dr. Watson, deliberately try to enhance the illusion of reality by commenting on the Holmesian adventures as if they were factual reports. So Hedgpeth, a marine zoologist, studied "The Adventure of the Lion's Mane" and presented his conclusions to "The Scowrers," a chapter of The Baker Street Irregulars in San Francisco. The editor requested and obtained the privilege of publishing the manuscript, with the understanding that its background would be temporarily concealed. We hope that our little hoax amused more readers than it puzzled and that all who read the article learned painlessly something about jellyfish.

That is an aim of the SM—to make casual learning not only painless but pleasant by whatever literary devices can be successfully employed. Sherlock Holmes himself would have had no use for the SM, but Dr. Watson might have enjoyed it. Speaking of "A Study in Scarlet," Holmes said sadly to Watson: "I glanced over it. Honestly, I cannot congratulate you upon it. Detection is, or ought to be, an exact science and should be treated in the same cold and unemotional manner. You have attempted to tinge it with romanticism, which produces much the same effect as if you worked a love-story or an elopement into the fifth proposition of Euclid." We have no intention of working fiction into the SM, but who can deny that Dr. Watson knew how to reach and hold his public? The moral is that Holmes' "cold and unemotional" ideal, which he disregarded in the "Lion's Mane," should be avoided in the SM.

Some scientists have become so accustomed to conventional scientific writing that it is difficult for them to break away from it on occasion; they not only must overcome a fixed habit but also a psychological hazard. Would they not lose caste scientifically if they were to depart from the third person and the passive voice? What would their colleagues think of them if they were caught in the first person surrounded by figures of speech? Our guess is that their unconventionality, if well done, would be vigorously applauded, for scientists are human and are not stirred by passages like the following: "The method of snowflake and appleblossom (1945) was investigated by the present author, as described above. The results so obtained are given in Table I where they are compared with those secured by the author with his own method . . . " [and so on, far into the night]. Scientific papers were not always as dull as they are now. In the early days it was not considered indelicate to write in the first person and to inject some Watsonian enthusiasm into the search.

Scientists have stories to tell that are intrinsically as interesting as any told by Conan Doyle. Like Holmes, they are in the business of detection, of analysis from effect to cause. Cannot Watson teach them something about telling the stories of their successes? Watson never neglected the human element in Holmes' problem. He resorted to dialogue, description, and to all the devices of the novelist; and he never, never added footnotes and references to the literature.

We are not suggesting that each contributor to the SM could or should become a novelist, but let him bear in that direction and at least avoid conventional scientific writing, footnotes, and bibliographies. The editor has tried to interest certain scientists in writing personal accounts of their most thrilling discoveries—to tell the reader what they wanted to find out, how they went about it, what obstacles they overcame, and how they arrived at the goal. And interwoven in the story should run the thread of emotion—of hope, despair, and joy. However useful the end products of research may be, it is "The Journey, not the Goal" (Curt Stern) that carries the true message.

The few scientists whom the editor consulted agreed that something of the kind should be done, but no one of them was willing to break the ice; they are modest men and could not face the possibility of being regarded as exhibitionists. But such articles would be identified with the editor's request. If that were not sufficient, the author might write about his own work as if it were the work of another. And still other ways might be found to make science flame in print. The editor eagerly awaits responses from those gallant souls who are willing to experiment with literary expression as well as with scientific instruments.—Ed.